DEPARTMENT OF COMMERCE

National Oceanic and Atmospheric Administration

RIN 0648–XW13

Takes of Marine Mammals Incidental to Specified Activities; Taking Marine Mammals Incidental to Open Water Marine Seismic Survey in the Chukchi Sea, Alaska

AGENCY: National Marine Fisheries Service (NMFS), National Oceanic and Atmospheric Administration (NOAA), Commerce.

ACTION: Notice; issuance of an incidental take authorization.

SUMMARY: In accordance with the Marine Mammal Protection Act (MMPA) regulations, notification is hereby given that NMFS has issued an Incidental Harassment Authorization (IHA) to Statoil USA E&P Inc. (Statoil) to take, by harassment, small numbers of 12 species of marine mammals incidental to a marine seismic survey program in the Chukchi Sea, Alaska, during the 2010 Arctic open water season.

DATES: Effective August 6, 2010, through November 30, 2010.

ADDRESSES: Inquiry for information on the incidental take authorization should be addressed to Michael Payne, Chief, Permits, Conservation and Education Division, Office of Protected Resources, National Marine Fisheries Service, 1315 East-West Highway, Silver Spring, MD 20910. A copy of the application containing a list of the references used in this document, NMFS' Environmental Assessment (EA) and Finding of No Significant Impact (FONSI), and the IHA may be obtained by writing to the address specified above, telephoning the contact listed below (*see* **FOR FURTHER INFORMATION CONTACT**), or visiting the Internet at: *http://www.nmfs.noaa.gov/pr/permits/incidental.htm#applications.*

Documents cited in this notice may be viewed, by appointment, during regular business hours, at the aforementioned address.

FOR FURTHER INFORMATION CONTACT: Shane Guan, Office of Protected Resources, NMFS, (301) 713–2289 or Brad Smith, NMFS, Alaska Region, (907) 271–3023.

SUPPLEMENTARY INFORMATION:

Background

Sections 101(a)(5)(A) and (D) of the MMPA (16 U.S.C. 1361 *et seq.*) direct the Secretary of Commerce to allow, upon request, the incidental, but not intentional, taking of small numbers of marine mammals by U.S. citizens who engage in a specified activity (other than commercial fishing) within a specified geographical region if certain findings are made and either regulations are issued or, if the taking is limited to harassment, a notice of a proposed authorization is provided to the public for review.

Authorization for incidental takings shall be granted if NMFS finds that the taking will have a negligible impact on the species or stock(s), will not have an unmitigable adverse impact on the availability of the species or stock(s) for subsistence uses (where relevant), and if the permissible methods of taking and requirements pertaining to the mitigation, monitoring and reporting of such takings are set forth. NMFS has defined "negligible impact" in 50 CFR 216.103 as "* * * an impact resulting from the specified activity that cannot be reasonably expected to, and is not reasonably likely to, adversely affect the species or stock through effects on annual rates of recruitment or survival."

Section 101(a)(5)(D) of the MMPA established an expedited process by which citizens of the U.S. can apply for an authorization to incidentally take small numbers of marine mammals by harassment. Except with respect to certain activities not pertinent here, the MMPA defines "harassment" as:

> Any act of pursuit, torment, or annoyance which (i) has the potential to injure a marine mammal or marine mammal stock in the wild ["Level A harassment"]; or (ii) has the potential to disturb a marine mammal or marine mammal stock in the wild by causing disruption of behavioral patterns, including, but not limited to, migration, breathing, nursing, breeding, feeding, or sheltering ["Level B harassment"].

Section 101(a)(5)(D) establishes a 45-day time limit for NMFS review of an application followed by a 30-day public notice and comment period on any proposed authorizations for the incidental harassment of marine mammals. Within 45 days of the close of the comment period, NMFS must either issue or deny the authorization.

Summary of Request

NMFS received an application on December 24, 2009, from Statoil for the taking, by harassment, of marine mammals incidental to 3D and 2D marine seismic surveys in the Chukchi Sea, Alaska, during the 2010 open-water season. After addressing comments from NMFS, Statoil modified its application and submitted a revised application on April 12, 2010. The April 12, 2010, application was the one available for public comment (see **ADDRESSES**) and considered by NMFS for the IHA.

The marine seismic survey will use two towed airgun arrays consisting of 26 active (10 spare) airguns with a maximum discharge volume of 3,000 cubic inch (in^3). The 3D survey will take place in a 915 mi^2 (2,370 km^2) survey area approximately 150 mi (241 km) west of Barrow in water depth of approximately 100 to 165 ft (30 to 50 m). The seismic survey is designed to collect 3D data of the deep sub-surface in Statoil's Chukchi leases in support of future oil and gas development within the area of coverage. The data will help identify source rocks, migration pathways, and play types. In addition, a 2D tie line survey has been designed as a second priority program to acquire useful information in the region. The four stand alone 2D lines (with a total length of approximately 420 mi or 675 km) are designed to tie the details of the new high resolution 3D image to the surrounding regional geology to facilitate interpretation of more regional trends. The number of 2D km acquired will to some degree be dependent on the 2010 season's restrictive ice coverage and the 3D data acquisition progress.

Statoil intends to conduct these marine surveys during the 2010 Arctic open-water season (July through November). Impacts to marine mammals may occur from noise produced by airgun sources used in the surveys.

Description of the Specified Activity

Statoil plans to conduct geophysical data acquisition activities in the Chukchi Sea in the period late July through the end of November, 2010. Data acquisition is expected to take approximately 60 days (including anticipated downtime), but the total period for this request was from July 25 through November 30 to allow for unexpected downtime (the IHA became effective on August 6, 2010). The project area encompasses approximately 915 mi^2 (2,370 km^2) in Statoil lease holdings in the Bureau of Ocean Energy Management, Regulation, and Enforcement's (BOEMRE) (formerly the Minerals Management Service) Outer Continental Shelf (OCS) Lease Sale 193 area in the northern Chukchi Sea (Figure 1 of the Statoil IHA application). The activities consist of 3D seismic data acquisition and a 2D tie line survey as a second priority program.

The entire 3D program, if it can be completed, will consist of approximately 3,100 mi (4,990 km) of production line, not including line turns. A total of four 2D well tie lines with a total length of approximately 420 mi (675 km) are included in the survey

plan as a second priority program. The 3D seismic data acquisition will be conducted from the M/V Geo Celtic. The M/V Geo Celtic will tow two identical airgun arrays at approximately 20 ft (6 m) depth and at a distance of about 902 ft (275 m) behind the vessel. Each array is composed of three strings for a total of 26 active G-guns (4×60 in^3, 8×70 in^3, 6×100 in^3, 4×150 in^3, and 4×250 in^3) with a total discharge volume of 3000 in^3. Each array also consists of 5 clusters of 10 inactive airguns that will be used as spares. One of the smallest guns in the array (60 in^3) will be used as the mitigation gun. More details of the airgun array and its components are described in Appendix B of Statoil's IHA application. In addition to the airgun array, pinger systems (DigiRANGE II, or similar systems) will be used to position the streamer array relative to the vessel.

The estimated source level for the full 3000 in^3 array is 245 dB re 1 μPa (rms) at 1 m. The maximum distances to received levels of 190, 180 160, and 120 dB re 1 μPa (rms) from sound source verification (SSV) measurements of the 3,147 in^3 airgun array used in the Chukchi Sea during 2006–2008 were used to model the received levels at these distances, which show that the maximum distances are 700, 2,500, 13,000, and 120,000 m, respectively. The SSV tests will provide received sound measurements in 10–dB increments between 120–190–dB isopleths. NMFS does not consider marine mammals exposed to impulse sounds below the 160 dB received level to be taken. The sole purpose of measuring to the 120 dB distance is to assess how far the sound source attenuates in the Arctic for the proposed seismic survey and the resulting information has not been factored into NMFS' MMPA decision for the Statoil seismic activities.

The estimated source level of the mitigation gun (*i.e.,* the single 60 in^3 airgun noted above) is 230 dB re 1 μPa (rms) at 1 m, and the modeled distances to received levels of 190, 180 160, and 120 dB re 1 μPa (rms) are 75, 220, 1,800, and 50,000 m, respectively.

The DigiRANGE II pinger system produces very short pulses, occurring for 10 ms, with source levels of approximately 180 dB re 1 μPa (rms) at 1 m at 55 kHz, 188 dB re 1 μPa (rms) at 1 m at 75 kHz, and 184 dB re 1 μPa (rms) at 1 m at 95 kHz. One pulse is emitted on command from the operator aboard the source vessel, which under normal operating conditions is once every 10 s. Most of the energy in the sound pulses emitted by this pinger is between 50 and 100 kHz. The signal is omnidirectional. Using a simple spherical spreading modeling for sound propagation, the calculated distances to received levels of 180, 160, and 120 dB re 1 μPa (rms) are 2.5 m, 25 m, and 2,512 m, respectively. These distances are well within the radii for airgun arrays and that of a single mitigation gun.

The vessel will travel along pre-determined lines at a speed of about 4–5 knots while one of the airgun arrays discharges every 8–10 seconds (shot interval 61.52 ft [18.75 m]). The streamer hydrophone array will consist of twelve streamers of up to approximately 2.2 mi (4 km) in length, with a total of 20,000–25,000 hydrophones at 6.6 ft (2 m) spacing. This large hydrophone streamer receiver array, designed to maximize efficiency and minimize the number of source points, will receive the reflected signals from the airgun array and transfer the data to an on-board processing system.

A 2D tie line survey has been designed as a second priority program to allow the vessel to acquire useful information in the region. The four stand alone 2D lines have a total length of approximately 420 mi (675 km) and are designed to tie the details of the new high resolution 3D image to known surrounding regional geology.

The approximate boundaries of the total surface area are between 71°30′ N and 72°00′ N and between 165° W and 162°30′ W. The water depth in the survey area varies from 100 to 165 ft (30 to 50 m).

The vessels involved in the seismic survey activities will consist of at least three vessels as listed below. Specifications of these vessels (or equivalent vessels if availability changes) are provided in Appendix A of Statoil's IHA application.

- One (1) seismic source vessel, the M/V Geo Celtic or similar equipped vessel, to tow the two 3,000 in^3 airgun arrays and hydrophone streamer for the 3D (and 2D) seismic data acquisition and to serve as a platform for marine mammal monitoring;
- One (1) chase/monitoring vessel, the M/V Gulf Provider or similar equipped vessel, for marine mammal monitoring, crew transfer, support and supply duties.
- One (1) chase/monitoring vessel, the M/V Thor Alpha or similar equipped vessel, for marine mammal monitoring, support and supply duties.

The M/V Geo Celtic, or similar vessel, arrived in Dutch Harbor around mid July 2010. The vessels were resupplied and the crew changed at this port. All three vessels had departed Dutch Harbor at the end of July with an expected transit time of approximately 5 days (weather depending). Directly upon arrival in the 3D survey area, depending on ice conditions, the M/V Geo Celtic will deploy the airgun array and start operating their guns for the purpose of sound source verification measurements (see Statoil IHA application for more details). The startup date of seismic data acquisition is expected to be early/mid August but depends on local ice conditions.

Upon completion of these measurements the seismic data acquisition in the Chukchi Sea will start and, depending on the start date, is expected to be completed in the first half of October. This is based on an estimated duration of 60 days from first to last shot point (including anticipated downtime). The data acquisition is a 24-hour operation.

Comments and Responses

A notice of NMFS' proposal to issue an IHA to Statoil published in the **Federal Register** on June 8, 2010 (75 FR 32379). That notice described, in detail, Statoil's proposed activity, the marine mammal species that may be affected by the activity, and the anticipated effects on marine mammals. During the 30-day public comment period, NMFS received five comment letters from the following: The Marine Mammal Commission (Commission); the Alaska Eskimo Whaling Commission (AEWC); the North Slope Borough Office of the Mayor (NSB); and Alaska Wilderness League (AWL), Audubon Alaska, Center for Biological Diversity, Defenders of Wildlife, Earthjustice, Greenpeace, Natural Resources Defense Council, Northern Alaska Environmental Center, Ocean Conservancy, Oceana, Pacific Environment, Sierra Club, and World Wildlife Fund (collectively "AWL"), along with an attached letter from Dr. David E. Bain, a contract scientist for NMFS.

The AEWC submitted several journal articles as attachments to its comment letters. NMFS acknowledges receipt of these documents but does not intend to address the specific articles themselves in the responses to comments, since these articles are merely used as citations in AEWC's comments. AEWC also submitted copies of 2009 and 2010 Conflict Avoidance Agreement (CAA), since Statoil declined to sign the CAA. Dr. Bain also attached an in-review journal article he coauthored. Any comments specific to Statoil's application that address the statutory and regulatory requirements or findings NMFS must make to issue an IHA are addressed in this section of the **Federal Register** notice.

General Comments

Comment 1: AEWC believes that NMFS should not issue incidental take authorizations for oil and gas-related activities given the current suspension of offshore drilling in Alaska and pending reorganization of the Minerals Management Service (MMS). AEWC points out that the harm caused by an oil spill is not the only risk to marine mammals posed by oil and gas activities on the OCS and that there are concerns regarding underwater noise from geophysical activities and the threats posed to marine mammals from noise and chemical pollution, as well as increased vessel traffic. AEWC further claims that many times, NMFS issued IHAs over the objections of the scientific and subsistence communities as well as the agencies' own scientists.

Response: The legal requirements and underlying analysis for the issuance of an IHA concerning take associated with seismic activities are unrelated to the moratorium on offshore drilling and reorganization of the MMS. In order to issue an authorization pursuant to Section 101(a)(5)(D) of the MMPA, NMFS must determine that the taking by harassment of small numbers of marine mammals will have a negligible impact on affected species or stocks, and will not have an unmitigable adverse impact on the availability of affected species or stocks for taking for subsistence uses. If NMFS is able to make these findings, the Secretary is required to issue an IHA. In the case of Statoil's activities for 2010 (as described in the application, the notice of proposed IHA (75 FR 32379; June 8, 2010) and this document), NMFS determined that it was able to make the required MMPA findings. Additionally, as described later in this section and throughout this document, NMFS has determined that Statoil's activities will not result in injury or mortality of marine mammals, and no injury or mortality is authorized under the IHA.

As discussed in detail in the proposed IHA (75 FR 32379; June 18, 2010), the EA for the issuance of IHAs to Shell and Statoil for the proposed open water marine and seismic surveys, and this document, NMFS has conducted a thorough analysis of the potential impacts of underwater anthropogenic sound (especially sound from geophysical surveys) on marine mammals. We have cited multiple studies and research that support NMFS MMPA and National Environmental Policy Act (NEPA) determinations that the localized and short-term disturbance from seismic surveys, with strict mitigation and monitoring measures implemented, are likely to result in negligible impacts to marine mammals and their habitat and no significant impact to the human environment, respectively. Although issuance of the IHA may be of concern to certain members of the public, the proposed issuance of the IHA was carefully reviewed and analyzed by NMFS scientists at headquarters and through Endangered Species Act (ESA) section 7 consultation at NMFS Alaska Regional Office, and by an independent bioacoustics expert. Based on those reviews, NMFS staff in the Office of Protected Resources made appropriate changes to this document.

Comment 2: The Commission requests that NMFS clarify whether the 3D and 2D seismic surveys will occur simultaneously or independent of one another and, if they will occur independently, recalculate the total exposed area and subsequent exposures for the 2D surveys.

Response: As stated in Statoil's IHA application, the 3D and 2D seismic surveys will occur independently. The total exposed area and subsequent exposures for the 2D surveys are reported in Statoil's IHA application.

MMPA Concerns

Comment 3: AEWC notes their disappointment in NMFS for releasing for public comment an incomplete application from Statoil that fails to provide the mandatory information required by the MMPA and NMFS' implementing regulations. AEWC requests that NMFS return Statoil's application as incomplete, or else the agency risks making arbitrary and indefensible determinations under the MMPA. The following is the information that AEWC believes to be missing from Statoil's application: (1) For several species, a thorough "description of the status, distribution, and seasonal distribution (when applicable) of the affected species or stocks of marine mammals likely to be affected" (50 CFR 216.104(a)(4)); (2) a description of the "age, sex, and reproductive condition" of the marine mammals that will be impacted, particularly in regard to bowhead whales (50 CFR 216.104(a)(6)); (3) an adequate detailing of "the anticipated impact of the activity upon the species or stock of marine mammals" (50 CFR 216.104(a)(7)); (4) the economic "availability and feasibility * * * of equipment, methods, and manner of conducting such activity or other means of effecting the least practicable adverse impact upon the affected species or stocks, their habitat, and on their availability for subsistence uses, paying particular attention to rookeries, mating grounds, and areas of similar significance" (50 CFR 216.104(a)(11)); and (5) suggested means of learning of, encouraging, and coordinating any research related activities (50 CFR 216.104(a)(14)). NSB also notes its concern about the lack of specificity regarding the timing and location of the proposed surveys, as well as the lack of specificity regarding the surveys themselves.

Response: NMFS does not agree that it released an incomplete application for review during the public comment period. After NMFS' initial review of the application, NMFS submitted questions and comments to Statoil on its application. After receipt and review of Statoil's responses, which were incorporated into the final version of the IHA application that was released to the public for review and comment, NMFS made its determination of completeness and released the application, addenda, and the proposed IHA notice (75 FR 32379; June 8, 2010). Regarding the three specific pieces of information believed to be missing by AEWC, Statoil's original application included a description of the pieces of information that are required pursuant to 50 CFR 216.104(a)(12).

Information required pursuant to 50 CFR 216.104(a)(4) and (6) requires that an applicant submit information on the "status, distribution, and seasonal distribution (when applicable) of the affected species or stocks of marine mammals likely to be affected" and "age, sex, and reproductive condition (if possible)" of the number of marine mammals that may be taken, respectively. In the application, Statoil described the species expected to be taken by harassment and provided estimates of how many of each species were expected to be taken during their activities. The status and distribution of these species are included in Section IV of Statoil's IHA application, the proposed IHA (75 FR 32379; June 8, 2010), and in this document. However, in most cases, it is difficult to estimate how many animals, especially cetaceans, of each age, sex, and reproductive condition will be taken or impacted by seismic surveys, because group composition of animals varies greatly by time and space.

In Section VII of Statoil's IHA application, the proposed IHA (75 FR 32379; June 8, 2010), and in this document, detailed discussion on the anticipated impacts from the proposed Statoil open water seismic survey in the Chukchi is provided, as required under 50 CFR 216.104(a)(7). The description of the anticipated impacts includes

discussions on potential effects from airgun noise and pinger signers.

Statoil also provided information on economic "availability and feasibility * * * of equipment, methods, and manner of conducting such activity or other means of effecting the least practicable adverse impact upon the affected species or stocks, their habitat, and on their availability for subsistence uses, paying particular attention to rookeries, mating grounds, and areas of similar significance" (50 CFR 216.104(a)(11)) in its IHA application. In its application, Statoil states that four main mitigations regarding the open water marine seismic survey in the Chukchi Sea are proposed: (1) Timing and locations for active survey acquisition work; (2) to configure airguns in a manner that directs energy primarily down to the seabed thus decreasing the range of horizontal spreading of noise; (3) using an energy source which is as small as possible while still accomplishing the survey objectives; and (4) curtailing active survey work when the marine mammal observers sight visually (from shipboard) the presence of marine mammals within identified ensonified zones. Details of these mitigation measures are discussed further in the 4MP that is included in Statoil's IHA application. In addition to these measures, NMFS' Notice of Proposed IHA (75 FR 32379; June 8, 2010) described mitigation measures proposed to be implemented by Statoil (outlined in the application), as well as additional measures proposed by NMFS for inclusion in an IHA.

Lastly, information required pursuant to 50 CFR 216.104(a)(14) was also included in Statoil's application. Statoil states that it will cooperate with any number of external entities, including other energy companies, agencies, universities, and NGOs, in its efforts to manage, understand, and fully communicate information about environmental impacts related to seismic activities. Statoil is a member of the OGP E&P Sound & Marine Life joint industry programme (JIP), which is an international consortium of oil and gas companies organized under the OGP in London. The objective of the JIP program is to obtain valid data on the effects of sounds produced by the gas exploration and production industry on marine life. Additionally, Statoil, Shell, and ConocoPhillips (CPAI) are jointly funding an extensive science program in the Chukchi Sea, which will be carried out by Olgoonik-Fairweather LLC to continue the acoustic monitoring programs of 2006–2009 with a total of 44 acoustic recorders distributed both broadly across the Chukchi lease area and nearshore environment and intensively on the Statoil, Burger (Shell), and Klondike (CPAI) lease holdings. Please refer to Statoil's IHA application and the proposed IHA (75 FR 32379; June 8, 2010) for a detailed description of the science program.

In conclusion, NMFS believes that Statoil provided all of the necessary information to proceed with publishing a proposed IHA notice in the **Federal Register**.

Comment 4: AEWC and NSB state that NMFS failed to issue a draft authorization for public review and comment. The plain language of both the MMPA and NMFS' implementing regulations require that NMFS provide the opportunity for public comment on the "proposed incidental harassment authorization" (50 CFR 216.104(b)(1)(i); 16 U.S.C. 1371(a)(5)(D)(iii)) and not just on the application itself as NMFS has done here. Given Statoil's refusal to sign the CAA and without a complete draft authorization and accompanying findings, AEWC states that it cannot provide meaningful comments on Statoil's proposed activities, ways to mitigate the impacts of those activities on marine mammals, and measures that are necessary to protect subsistence uses and sensitive resources.

Response: The June 8, 2010 proposed IHA notice (75 FR 32379) contained all of the relevant information needed by the public to provide comments on the proposed authorization itself. The notice contained the permissible methods of taking by harassment, means of effecting the least practicable impact on such species (*i.e.,* mitigation), measures to ensure no unmitigable adverse impact on the availability of the species or stock for taking for subsistence use, requirements pertaining to the monitoring and reporting of such taking, including requirements for the independent peer review of the proposed monitoring plan. The notice provided detail on all of these points, and, in NMFS' view, allowed the public to comment on the proposed authorization and inform NMFS' final decision. Additionally, the notice contained NMFS' preliminary findings of negligible impact and no unmitigable adverse impact.

The signing of a CAA is not a requirement to obtain an IHA. The CAA is a document that is negotiated between and signed by the industry participant, AEWC, and the Village Whaling Captains' Associations. NMFS has no role in the development or execution of this agreement. Although the contents of a CAA may inform NMFS' no unmitigable adverse impact determination for bowhead and beluga whales and ice seals, the signing of it is not a requirement. While a CAA has not been signed and a final version agreed to by industry participants, AEWC, and the Village Whaling Captains' Associations, NMFS was provided with a copy of the version ready for signature by AEWC. NMFS has reviewed the CAA and included several measures from the document which relate to marine mammals and avoiding conflicts with subsistence hunts in the IHA. Some of the conditions which have been added to the IHA include: (1) Avoiding concentrations of whales and reducing vessel speed when near whales; (2) conducting sound source verification measurements; and (3) participating in the Communication Centers. Despite the lack of a signed CAA for 2010 activities, NMFS is confident that the measures contained in the IHA will ensure no unmitigable adverse impact to subsistence users.

Comment 5: AEWC and NSB argue that Statoil has not demonstrated that its proposed activities would take only "small numbers of marine mammals of a species or population stock," resulting in no more than a "negligible impact" on a species or stock. In addition, NSB argues that NMFS has not adequately analyzed harassment associated with received levels of noise below 160 dB.

Response: NMFS believes that it provided sufficient information in its proposed IHA notice (75 FR 32379; June 8, 2010) to make the small numbers and negligible impact determinations and that the best scientific information available was used to make those determinations. While some published articles indicate that certain marine mammal species may avoid seismic vessels at levels below 160 dB, NMFS does not consider that these responses rise to the level of a take as defined in the MMPA. While studies, such as Miller *et al.* (1999), have indicated that some bowhead whales may have started to deflect from their migratory path 35 km (21.7 mi) from the seismic vessel, it should be pointed out that these minor course changes are during migration and, as described in MMS' 2006 Final Programmatic Environmental Assessment (PEA), have not been seen at other times of the year and during other activities. To show the contextual nature of this minor behavioral modification, recent monitoring studies of Canadian seismic operations indicate that feeding, non-migratory bowhead whales do not move away from a noise source at an SPL of 160 dB. Therefore, while bowheads may avoid an area of 20 km (12.4 mi) around a noise source, when that determination requires a

post-survey computer analysis to find that bowheads have made a 1 or 2 degree course change, NMFS believes that does not rise to a level of a "take," as the change in bearing is due to animals sensing the noise and avoiding passing through the ensonified area during their migration, and should not be considered as being displaced from their habitat. NMFS therefore continues to estimate "takings" under the MMPA from impulse noises, such as seismic, as being at a distance of 160 dB (re 1 μPa). As explained throughout this **Federal Register** notice, it is highly unlikely that marine mammals would be exposed to SPLs that could result in serious injury or mortality. The best scientific information indicates that an auditory injury is unlikely to occur, as apparently sounds need to be significantly greater than 180 dB for injury to occur (Southall *et al.* 2007).

Regarding the small number issue raised by the AEWC and NSB, NMFS has developed a series of estimates for marine mammals that could be taken as a result of Statoil's proposed marine surveys, and the estimated takes from these proposed activities are all under five percent for any affected marine mammal species or stock (see Potential Number of Takes by Harassment section below).

Impacts to Marine Mammals

Comment 6: AEWC notes that based on the density estimates, Statoil is predicting that an average of 2,253 and 4,234 individuals of Alaska ringed seals may be exposed to sound levels of 160 dB and above during the proposed 3D and 2D seismic surveys, respectively. AEWC and NSB state that these are by no means "small numbers" of marine mammals that will be subjected to impacts as a result of Statoil's operations.

Response: NMFS determined that the small numbers requirement has been satisfied. Statoil has predicted that an average of 2,253 and 4,234 individuals of Alaska ringed seals may be exposed to sound levels of 160 dB and above as the result of Statoil's proposed 3D and 2D marine seismic surveys, respectively, and NMFS assumes that animals exposed to received levels above 160 dB are taken. However, because of the tendency of marine mammals to avoid the source to some degree, and the fact that both the marine mammals and the source are moving through an area, the majority of the exposures would likely occur at levels closer to 160 dB (not higher levels) and the impacts would be expected to be relatively low-level and not of a long duration. NMFS assesses "small numbers" in terms relative to the population/stock size. The Level B harassment take estimate of a total of 6,487 Alaska stock of ringed seals is a small number in relative terms, because of the nature of the anticipated responses and in that it represents only 2.81 percent of the regional stock size of that species (population > 230,000), if each "exposure" at 160 dB represents an individual ringed seal. Furthermore, as discussed below, exposure of marine mammals to received levels at 160 dB do not always constitute a "take." Many animals may not respond to this level in a way that is considered biologically significant. Therefore, even though NMFS uses the 160 dB received level as the onset of Level B harassment for regulatory purposes, this does not mean that all animals exposed to this level or levels above 160 dB are "taken." Additionally, NMFS believes the percentage would be even lower if animals move out of the seismic area. In these circumstances, animals that are outside of the ensonified zone (e.g., the 160 dB isopleth) would not be expected to be taken by Level B harassment.

Comment 7: AWL, NSB, and AEWC noted that NMFS has acknowledged that permanent threshold shift (PTS) qualifies as a serious injury. Therefore, if an acoustic source at its maximum level has the potential to cause PTS and thus lead to serious injury, it would not be appropriate to issue an IHA for the activity (60 FR 28381; May 31, 1995). AEWC states that therefore an LOA is required here.

Response: In the proposed rule to implement the process to apply for and obtain an IHA, NMFS stated that authorizations for harassment involving the "potential to injure" would be limited to only those that may involve non-serious injury (60 FR 28379; May 31, 1995). While the **Federal Register** notice cited by the commenters states that NMFS considered PTS to be a serious injury (60 FR 28379; May 31, 1995), our understanding of anthropogenic sound and the way it impacts marine mammals has evolved since then, and NMFS no longer considers PTS to be a serious injury. NMFS has defined "serious injury" in 50 CFR 216.3 as "* * * any injury that will likely result in mortality." There are no data that suggest that PTS would be likely to result in mortality, especially the limited degree of PTS that could hypothetically be incurred through exposure of marine mammals to seismic airguns at the level and for the duration that are likely to occur in this action.

Further, as stated several times in this document and previous **Federal Register** notices for seismic activities, there is no empirical evidence that exposure to pulses of airgun sound can cause PTS in any marine mammal, even with large arrays of airguns (see Southall *et al.* 2007). PTS is thought to occur several decibels above that inducing mild temporary threshold shift (TTS), the mildest form of hearing impairment (a non-injurious effect). NMFS concluded that cetaceans and pinnipeds should not be exposed to pulsed underwater noise at received levels exceeding, respectively, 180 and 190 dB re 1 μPa (rms). The established 180 and 190 dB re 1 μPa (rms) criteria are the received levels above which, in the view of a panel of bioacoustics specialists convened by NMFS before TTS measurements for marine mammals started to become available, one could not be certain that there would be no injurious effects, auditory or otherwise, to marine mammals. As summarized later in this document, data that are now available imply that TTS is unlikely to occur unless bow-riding odontocetes are exposed to airgun pulses much stronger than 180 dB re 1 Pa rms (Southall *et al.* 2007). Additionally, NMFS has required monitoring and mitigation measures to negate the possibility of marine mammals being seriously injured as a result of Statoil's activities. In the proposed IHA, NMFS determined that Statoil's activities are unlikely to even result in TTS. Based on this determination and the explanation provided here, PTS is also not expected. Therefore, an IHA is appropriate.

Comment 8: AWL, NSB, and AEWC state that NMFS has not adequately considered whether marine mammals may be harassed at received levels significantly lower than 160 dB and that NMFS did not use the best scientific evidence in setting the sound levels against which take was assessed. They state that NMFS calculated harassment from Statoil's proposed surveying based on the exposure of marine mammals to sounds at or above 160 dB and that this uniform approach to harassment does not take into account known reactions of marine mammals in the Arctic to levels of noise far below 160 dB. These comments state that bowhead, gray, killer, and beluga whales and harbor porpoise react to sounds lower than 160 dB.

Citing several papers on killer whales and harbor porpoise, Dr. Bain states that major behavioral changes of these animals appear to be associated with received levels of around 135 dB re 1 μPa, and that minor behavioral changes can occur at received levels from 90–110 dB re 1 μPa or lower. He also states that belugas have been observed to respond to icebreakers by swimming rapidly away at distances up to 80 km,

where received levels were between 94 and 105 dB re 1 μPa. Belugas exhibited minor behavioral changes such as changes in vocalization, dive patterns, and group composition at distances up to 50 km (NRC 2003), where received levels were likely around 120 dB.

The AWL states that harbor porpoises have been shown to be particularly responsive to sound, exhibiting behavioral changes, including exclusion from an area, at received levels of 90–110 dB or lower (with received levels around 70–90 dB), depending on experience with the noise source and environmental context. The AWL listed a number of papers but did not point out the source of its statement. The AWL also states that multiple studies confirm the sensitivity of beluga whales, and that they are known to alter their migration paths in response to icebreaker noise at received levels as low as 80 dB, and that belugas have been observed to respond to icebreakers by swimming rapidly away at distances up to 80 km.

AEWC also states that in conducting scoping on its national acoustic guidelines for marine mammals, NMFS noted that the existing system for determining take (i.e., the 160 dB mark) "considers only the sound pressure level of an exposure but not its other attributes, such as duration, frequency, or repetition rate, all of which are critical for assessing impacts on marine Mammals" and "also assumes a consistent relationship between rms (root-mean-square) and peak pressure values for impulse sounds, which is known to be inaccurate under certain (many) conditions" (70 FR 1871, 1873; January 11, 2005). Thus, NMFS itself has recognized that 160 dB (rms) is not an adequate measure. AEWC argues that current scientific research establishes that 120 dB (rms) is a more appropriate measure for impacts to marine mammals.

Response: The best information available to date for reactions by bowhead whales to noise, such as seismic, is based on the results from the 1998 aerial survey (as supplemented by data from earlier years) as reported in Miller *et al.* (1999). In 1998, bowhead whales below the water surface at a distance of 20 km (12.4 mi) from an airgun array received pulses of about 117–135 dB re 1 μPa rms, depending upon propagation. Corresponding levels at 30 km (18.6 mi) were about 107–126 dB re 1 μPa rms. Miller *et al.* (1999) surmise that deflection may have begun about 35 km (21.7 mi) to the east of the seismic operations, but did not provide SPL measurements to that distance and noted that sound propagation has not been studied as extensively eastward in the alongshore direction, as it has northward, in the offshore direction. Therefore, while this single year of data analysis indicates that bowhead whales may make minor deflections in swimming direction at a distance of 30–35 km (18.6–21.7 mi), there is no indication that the SPL where deflection first begins is at 120 dB; it could be at another SPL lower or higher than 120 dB. Miller *et al.* (1999) also note that the received levels at 20–30 km (12.4–18.6 mi) were considerably lower in 1998 than have previously been shown to elicit avoidance in bowheads exposed to seismic pulses. However, the seismic airgun array used in 1998 was larger than the ones used in 1996 and 1997. Therefore, NMFS believes that it cannot scientifically support adopting any single SPL value below 160 dB and apply it across the board for all species and in all circumstances. Second, these minor course changes occurred during migration and, as indicated in MMS' 2006 PEA, have not been seen at other times of the year and during other activities. Third, as stated in the past, NMFS does not believe that minor course corrections during a migration equate to "take" under the MMPA. This conclusion is based on controlled exposure experiments conducted on migrating gray whales exposed to the U.S. Navy's low frequency sonar (LFA) sources (Tyack 2009). When the source was placed in the middle of the migratory corridor, the whales were observed deflecting around the source during their migration. However, such minor deflection is considered not to be biologically significant. To show the contextual nature of this minor behavioral modification, recent monitoring studies of Canadian seismic operations indicate that when, not migrating, but involved in feeding, bowhead whales do not move away from a noise source at an SPL of 160 dB. Therefore, while bowheads may avoid an area of 20 km (12.4 mi) around a noise source, when that determination requires a post-survey computer analysis to find that bowheads have made a 1 or 2 degree course change, NMFS believes that does not rise to a level of a "take." NMFS therefore continues to estimate "takings" under the MMPA from impulse noises, such as seismic, as being at a distance of 160 dB (re 1 μPa). Although it is possible that marine mammals could react to any sound levels detectable above the ambient noise level within the animals' respective frequency response range, this does not mean that such animals would react in a biologically significant way. According to experts on marine mammal behavior, the degree of reaction which constitutes a "take," i.e., a reaction deemed to be biologically significant that could potentially disrupt the migration, breathing, nursing, breeding, feeding, or sheltering, etc., of a marine mammal is complex and context specific, and it depends on several variables in addition to the received level of the sound by the animals. These additional variables include, but are not limited to, other source characteristics (such as frequency range, duty cycle, continuous vs. impulse vs. intermittent sounds, duration, moving vs. stationary sources, etc.); specific species, populations, and/or stocks; prior experience of the animals (naive vs. previously exposed); habituation or sensitization of the sound by the animals; and behavior context (whether the animal perceives the sound as predatory or simply annoyance), etc. (Southall *et al.* 2007). Furthermore, the behavioral responses by harbor porpoises (pinger) and beluga whales (icebreaker) were to non-impulse noises. For non-impulse noise sources, research shows that in general, the threshold that induces behavioral responses among animals tends to be much lower. Therefore, NMFS uses 120 dB as the onset for behavioral harassment for non-impulse noises but 160 dB for impulse noises. The noises from the proposed marine seismic survey from airgun arrays are pulses.

The references cited in the comment letters address different source characteristics (continuous sound rather than impulse sound that are planned for the proposed seismic survey) or species (killer whales and harbor porpoises) that rarely occur in the proposed Arctic action area. Some information about the responses of bowhead and gray whales to seismic survey noises has been acquired through dedicated research and marine mammal monitoring studies conducted during prior seismic surveys. Detailed descriptions regarding behavioral responses of these marine mammals to seismic sounds are available (*e.g.,* Richardson *et al.* 1995; review by Southall *et al.* 2007), and are also discussed in this document. Additionally, as Statoil does not intend to use ice-breakers during its operations, statements regarding beluga reactions to icebreaker noise are not relevant to this activity.

Regarding the last point raised in this comment by AEWC, NMFS recognizes the concern. However, NMFS does not agree with AEWC's statement that current scientific research establishes that 120 dB (rms) is a more appropriate measure for impacts to marine mammals

for reasons noted above. Based on the information and data summarized in Southall *et al.* (2007), and on information from various studies, NMFS believes that the onset for behavioral harassment is largely context dependent, and there are many studies showing marine mammals do not show behavioral responses when exposed to multiple pulses at received levels above 160 dB re 1 µPa (e.g., Malme *et al.* 1983; Malme *et al.* 1984; Richardson *et al.* 1986; Akamatsu *et al.* 1993; Madsen and Møhl 2000; Harris *et al.* 2001; Miller *et al.* 2005). Therefore, although using a uniform SPL of 160–dB for the onset of behavioral harassment for impulse noises may not capture all of the nuances of different marine mammal reactions to sound, it is an appropriately conservative way to manage and regulate anthropogenic noise impacts on marine mammals. Therefore, unless and until an improved approach is developed and peer-reviewed, NMFS will continue to use the 160–dB threshold for determining the level of take of marine mammals by Level B harassment for impulse noise (such as from airguns).

Comment 9: NSB and AWL note that this IHA, as currently proposed, is based on uncertainties that are not allowed under the MMPA. Citing comments made by NMFS on recent MMS Lease Sale Environmental Impact Statements, NSB notes that NMFS stated that without more current and thorough data on the marine mammals in the Chukchi Sea and their use of these waters, it would be difficult to make the findings required by the MMPA. AWL points out that NMFS specifically observed that activities "occurring near productive forage areas such as the Hanna Shoal" or "along migratory corridors" are most likely to encounter and impact marine mammals. AWL states that Statoil's proposed surveying will likely take place proximate to the Hanna Shoal, which is a feeding ground for gray whales and is within the pathway for migrating bowheads. AWL furthers states that the lack of information runs up against the precautionary nature of the MMPA, therefore, NMFS cannot claim the lack of available information justifies its decision, and that NMFS has an affirmative obligation to find that impacts are no more than "negligible" and limited to the harassment of only "small numbers of marine mammals." NSB notes that NMFS noted that the "continued lack of basic audiometric data for key marine mammal species" that occur throughout the Chukchi Sea inhibits the "ability to determine the nature and biological significance of exposure to various levels of both continuous and impulsive oil and gas activity sounds."

Response: While there may be some uncertainty on the current status of some marine mammal species in the Chukchi Sea and on impacts to marine mammals from seismic surveys, the best available information supports our findings. NMFS is currently proposing to conduct new population assessments for Arctic pinniped species, and current information is available on-line through the Stock Assessment Reports (SARs). Moreover, NMFS has required the industry to implement a monitoring and reporting program to collect additional information concerning effects to marine mammals.

In regard to impacts, there is no indication that seismic survey activities are having a long-term impact on marine mammals. For example, apparently, bowhead whales continued to increase in abundance during periods of intense seismic activity in the Chukchi Sea in the 1980s (Raftery *et al.* 1995; Angliss and Outlaw 2007), even without implementation of current mitigation requirements. As a result, NMFS believes that seismic survey noise in the Arctic will affect only small numbers of and have no more than a negligible impact on affected marine mammal species or stocks in the Chukchi Sea. As explained in this document and based on the best available information, NMFS has determined that Statoil's activities will affect only small numbers of marine mammal species or stocks, will have a negligible impact on affected species or stocks, and will not have an unmitigable adverse impact on subsistence uses of the affected species or stocks.

Comment 10: AWL and NSB state that the standard for determining whether an IHA is appropriate is exceptionally protective. If there is even the possibility of serious injury, NMFS must establish that the "potential for serious injury can be negated through mitigation requirements" (60 FR 28380; May 31, 1995). Reports from previous surveys, however, indicate that, despite monitored exclusion zones, marine mammals routinely stray too close to the airguns. AEWC states that the safety radii proposed by Statoil do not negate injury.

Response: As has already been stated in the **Federal Register** notice for the proposed IHA (75 FR 32379; June 8, 2010), recent scientific information has indicated that received noise levels need to be significantly higher than 190 dB to cause injury to marine mammals (see Southall *et al.* 2007). Therefore, the 180- and 190-dB safety zones are conservative.

The source vessel will be traveling at speeds of about 1–5 knots (1.9–9.3 km/hr). With a 180-dB safety range of 160 m (525 ft), the vessel will have moved out of the safety zone within a few minutes. As a result, during underway survey operations, MMOs are instructed to concentrate on the area ahead of the vessel, not behind the vessel where marine mammals would need to be voluntarily swimming towards the vessel to enter the 180-dB zone. In fact, in some of NMFS' IHAs issued for scientific seismic operations, shutdown is not required for marine mammals that approach the vessel from the side or stern in order to ride the bow wave or rub on the seismic streamers deployed from the stern (and near the airgun array) as some scientists consider this a voluntary action on the part of an animal that is not being harassed or injured by seismic noise. While NMFS concurs that shutdowns are not likely warranted for these voluntary approaches, in the Arctic Ocean, all seismic surveys are shutdown or powered down for all marine mammal close approaches. Also, in all seismic IHAs, including Statoil's IHA, NMFS requires that the safety zone be monitored for 30 min prior to beginning ramp-up to ensure that no marine mammals are present within the safety zones. Implementation of ramp-up is required because it is presumed it would allow marine mammals to become aware of the approaching vessel and move away from the noise, if they find the noise annoying. Data from 2007 and 2008, when Shell had support boats positioned 1 km (0.62 mi) on each side of the 3D seismic vessel, suggest that marine mammals do in fact move away from an active source vessel. In those instances, more seals were seen from the support vessels than were seen from the source vessels during active seismic operations. Additionally, research has indicated that some species tend to avoid areas of active seismic operations (e.g., bowhead whales, see Richardson *et al.* 1999).

NMFS has determined that an IHA is the proper authorization required to cover Statoil's survey. As described in other responses to comments in this document, NMFS does not believe that there is a risk of serious injury or mortality from these activities. The monitoring reports from 2006, 2007, 2008, and 2009 do not note any instances of serious injury or mortality (Patterson *et al.* 2007; Funk *et al.* 2008; Ireland *et al.* 2009; Reiser *et al.* 2010). Additionally, NMFS is confident it has met all of the requirements of section 101(a)(5)(D) of the MMPA (as described

throughout this document) and therefore can issue an IHA to Statoil for its survey operations in 2010.

Comment 11: AEWC notes that stranded marine mammals or their carcasses are also a sign of injury. NMFS states in its notice that it "does not expect any marine mammal will * * * strand as a result of the proposed seismic survey" (75 FR 32379; June 8, 2010). In reaching this conclusion, NMFS claims that strandings have not been recorded for the Beaufort and Chukchi Seas. AEWC states that the Department of Wildlife Management of NSB has completed a study documenting 25 years worth of stranding data and showing that five dead whales were reported in 2008 alone in comparison with the five dead whales that were reported in the same area over the course of 25 years (Rosa 2009).

In light of the increase in seismic operations in the Arctic since 2006, AEWC says that NSB's study raises serious concerns about the impacts of these operations and their potential to injure marine mammals. AEWC states that while they think this study taken together with the June 2008 stranding of "melon headed whales off Madagascar that appears to be associated with seismic surveys" (75 FR 32379; June 8, 2010) demonstrate that seismic operations have the potential to injure marine mammals beyond beaked whales (and that Statoil needs to apply for an LOA for its operations), certainly NSB's study shows that direct injury of whales is on-going. AEWC states that these direct impacts must be analyzed and explanations sought out before additional activities with the potential to injure marine mammals are authorized, and that NMFS must explain how, in light of this new information, Statoil's application does not have the potential to injure marine mammals.

Response: NMFS has reviewed the information provided by AEWC regarding marine mammal strandings in the Arctic. The Rosa (2009) paper cited by AEWC does not provide any evidence linking the cause of death for the bowhead carcasses reported in 2008 to seismic operations. Additionally, the increased reporting of carcasses in the Arctic since 2006 may also be a result of increased reporting effort and does not necessarily indicate that there were fewer strandings prior to 2008. Marine mammal observers (MMOs) aboard industry vessels in the Beaufort and Chukchi Seas have been required to report sightings of injured and dead marine mammals to NMFS as part of the IHA requirements only since 2006.

Regarding the June 2008 stranding of melon headed whales off Madagascar, information available to NMFS at this time indicates that the seismic airguns were not active around the time of the stranding. While the Rosa (2009) study does present information regarding the injury of whales in the Arctic, it does not link the cause of the injury to seismic survey operations. As NMFS has stated previously, the evidence linking marine mammal strandings and seismic surveys remains tenuous at best. Two papers, Taylor *et al.* (2004) and Engel *et al.* (2004) reference seismic signals as a possible cause for a marine mammal stranding.

Taylor *et al.* (2004) noted two beaked whale stranding incidents related to seismic surveys. The statement in Taylor *et al.* (2004) was that the seismic vessel was firing its airguns at 1300 hrs on September 24, 2004, and that between 1400 and 1600 hrs, local fishermen found live stranded beaked whales 22 km (12 nm) from the ship's location. A review of the vessel's trackline indicated that the closest approach of the seismic vessel and the beaked whales stranding location was 18 nm (33 km) at 1430 hrs. At 1300 hrs, the seismic vessel was located 25 nm (46 km) from the stranding location. What is unknown is the location of the beaked whales prior to the stranding in relation to the seismic vessel, but the close timing of events indicates that the distance was not less than 18 nm (33 km). No physical evidence for a link between the seismic survey and the stranding was obtained. In addition, Taylor *et al.* (2004) indicates that the same seismic vessel was operating 500 km (270 nm) from the site of the Galapagos Island stranding in 2000. Whether the 2004 seismic survey caused the beaked whales to strand is a matter of considerable debate (see Cox *et al.* 2006). However, these incidents do point to the need to look for such effects during future seismic surveys. To date, follow up observations on several scientific seismic survey cruises have not indicated any beaked whale stranding incidents.

Engel *et al.* (2004), in a paper presented to the IWC in 2004 (SC/56/E28), mentioned a possible link between oil and gas seismic activities and the stranding of 8 humpback whales (7 off the Bahia or Espirito Santo States and 1 off Rio de Janeiro, Brazil). Concerns about the relationship between this stranding event and seismic activity were raised by the International Association of Geophysical Contractors (IAGC). The IAGC (2004) argues that not enough evidence is presented in Engel *et al.* (2004) to assess whether or not the relatively high proportion of adult strandings in 2002 is anomalous. The IAGC contends that the data do not establish a clear record of what might be a "natural" adult stranding rate, nor is any attempt made to characterize other natural factors that may influence strandings. As stated previously, NMFS remains concerned that the Engel *et al.* (2004) article appears to compare stranding rates made by opportunistic sightings in the past with organized aerial surveys beginning in 2001. If so, then the data are suspect.

Additionally, if bowhead and gray whales react to sounds at very low levels by making minor course corrections to avoid seismic noise, and mitigation measures require Statoil to ramp-up the seismic array to avoid a startle effect, strandings such as those observed in the Bahamas in 2000 are highly unlikely to occur in the Arctic Ocean as a result of seismic activity. Therefore, NMFS does not expect any marine mammals will incur serious injury or mortality as a result of Statoil's 2010 survey operations, so an LOA is not needed.

Lastly, Statoil is required to report all sightings of dead and injured marine mammals to NMFS and to notify the Marine Mammal Health and Stranding Response Network. However, Statoil is not permitted to conduct necropsies on dead marine mammals. Necropsies can only be performed by people authorized to do so under the Marine Mammal Health and Stranding Response Program MMPA permit. NMFS is currently considering different methods for marking carcasses to reduce the problem of double counting. However, a protocol has not yet been developed, so marking is not required in the IHA.

Comment 12: AEWC, NSB, and Dr. Bain state that research is increasingly showing that marine mammals may remain within dangerous distances of seismic operations rather than leave a valued resource such as a feeding ground (see Richardson 2004). The International Whaling Commission (IWC) scientific committee has indicated that the lack of deflection by feeding whales in Camden Bay (during Shell Offshore Inc. and Shell Gulf of Mexico Inc.'s seismic activities) likely shows that whales will tolerate and expose themselves to potentially harmful levels of sound when needing to perform a biologically vital activity, such as feeding (mating, giving birth, etc.). Thus, the noise from Statoil's proposed operations could injure marine mammals if they are close enough to the source. NSB further states that NMFS has not adequately analyzed the potential for serious injury.

Response: If marine mammals, such as bowhead whales, remain near a seismic operation to perform a biologically vital activity, such as feeding, depending on the distance from the vessel and the size of the 160-dB radius, the animals may experience some Level B harassment. A detailed analysis on potential impacts of anthropogenic noise (including noise from seismic airguns and other active acoustic sources used in geophysical surveys) is provided in the proposed IHA (75 FR 32379; June 8, 2010) and in this document. Based on the analysis, NMFS believes that it is unlikely any animals exposed to noise from Statoil's proposed marine surveys would be exposed to received levels that could cause TTS (a non-injurious Level B harassment). Therefore, it is even less likely that marine mammals would be exposed to levels of sound from Statoil's activity that could cause PTS (a non-lethal Level A harassment).

In addition, depending on the distance of the animals from the vessel and the number of individual whales present, certain mitigation measures are required to be implemented. If an aggregation of 12 or more mysticete whales are detected within the 160-dB radius, then the airguns must be shutdown until the aggregation is no longer within that radius. Additionally, if any whales are sighted within the 180-dB radius or any pinnipeds are sighted within the 190-dB radius of the active airgun array, then either a power-down or shutdown must be implemented immediately. For the reasons stated throughout this document, NMFS has determined that Statoil's operations will not injure, seriously injure, or kill marine mammals.

Comment 13: AEWC, AWL, and Dr. Bain state that NMFS does little to assess whether Level A harassment is occurring as a result of the deflection of marine mammals as a result of Statoil's proposed operations. Deflected marine mammals may suffer impacts due to masking of natural sounds including calling to others of their species, physiological damage from stress and other non-auditory effects, harm from pollution of their environment, tolerance, and hearing impacts (*see* Nieukirk *et al.* 2004). Not only do these operations disrupt the animals' behavioral patterns, but they also create the potential for injury by causing marine mammals to miss feeding opportunities, expend more energy, and stray from migratory routes when they are deflected.

Response: See the response to comment 8 regarding the potential for injury. The paper cited by AEWC (Nieukirk *et al.* 2004) tried to draw linkages between recordings of fin, humpback, and minke whales and airgun signals in the western North Atlantic; however, the authors note the difficulty in assessing impacts based on the data collected. The authors also state that the effects of airgun activity on baleen whales is unknown and then cite to Richardson *et al.* (1995) for some possible effects, which AEWC lists in their comment. There is no statement in the cited study, however, about the linkage between deflection and these impacts. While deflection may cause animals to expend extra energy, there is no evidence that this deflection is causing a significant behavioral change that will adversely impact population growth. In fact, bowhead whales continued to increase in abundance during periods of intense seismic in the Chukchi Sea in the 1980s (Raftery *et al.* 1995; Angliss and Outlaw 2007). Therefore, NMFS does not believe that injury will occur as a result of Statoil's activities. Additionally, Statoil's total data acquisition activities would only ensonify 531 km^2 of the Chukchi Sea to received levels above 160 dB (0.089% of the entire Chukchi Sea). Therefore, based on the small area of the Chukchi Sea where Statoil will utilize airguns, it is unlikely that marine mammals will need to expend much extra energy to locate prey, or will have reduced foraging opportunities.

Comment 14: Citing Erbe (2002), AEWC notes that any sound at some level can cause physiological damage to the ear and other organs and tissues. Placed in a context of an unknown baseline of sound levels in the Chukchi Sea, it is critically important that NMFS take a precautionary approach to permitting additional noise sources in this poorly studied and understood habitat. Thus, the best available science dictates that NMFS use a more cautious approach in addressing impacts to marine mammals from seismic operations. AWL also states noise exposure is likely to result in stress, and stress can impair an animal's immune system.

Response: The statement from Erbe (2002) does not take into account mitigation measures required in the IHA to reduce impacts to marine mammals. As stated throughout this document, based on the fact that Statoil will implement mitigation measures (*i.e.,* ramp-up, power-down, shutdown, etc.), NMFS does not believe that there will be any injury or mortality of marine mammals as a result of Statoil's operations.

Comment 15: AEWC states that in making its negligible impact determination, NMFS failed to consider several impacts: (1) Displacing marine mammals from feeding areas; (2) non-auditory, physiological effects, namely stress; (3) the possibility of vessel strikes needs to be considered in light of scientific evidence of harm from ship traffic to marine mammals; (4) impacts to marine mammal habitat, including pollution of the marine environment and the risk of oil spills, toxic, and nontoxic waste being discharged; (5) impacts to fish and other food sources upon which marine mammals rely; and (6) specific marine mammals that will be taken, including their age, sex, and reproductive condition. The first issue was also raised by Dr. Bain.

Response: NMFS does not agree that these impacts were not considered. First, the area that would be ensonified by Statoil's proposed open water seismic surveys represents a small fraction of the total habitat of marine mammals in the Chukchi Sea. In addition, as the survey vessel is constantly moving, the ensonified zone where the received levels exceed 160 dB re 1 μPa (rms), which is estimated to be approximately 531 km^2 at any given time, is constantly moving. Therefore, the duration during which marine mammals would potentially avoid the ensonified area would be brief. Therefore, NMFS does not believe marine mammals would be displaced from their customary feeding areas as a result of Statoil's proposed seismic surveys.

Second, non-auditory, physiological effects, including stress, were analyzed in the Notice of Proposed IHA (75 FR 32379; June 8, 2010). No single marine mammal is expected to be exposed to high levels of sound for extended periods based on the size of the airgun array to be used by Statoil and the fact that an animal would need to swim close to, parallel to, and at the same speed as the vessel to incur several high intensity pulses. This also does not take into account the mitigation measures described later in this document.

Third, impacts resulting from vessel strikes and habitat pollution and impacts to fish were fully analyzed in NMFS' 2010 Final EA for Shell and Statoil's open water marine and seismic activities (NMFS 2010). Additionally, the proposed IHA analyzed potential impacts to marine mammal habitat, including prey resources. That analysis noted that while mortality has been observed for certain fish species found in extremely close proximity to the airguns, Sætre and Ona (1996) concluded that mortality rates caused by

exposure to sounds are so low compared to natural mortality that issues relating to stock recruitment should be regarded as insignificant. For the sixth point, please see the response to comment 4. The age, sex, and reproductive condition must be provided when possible. However, this is often extremely difficult to predict. Additional mitigation measures for bowhead cow/calf pairs, such as monitoring the 120-dB radius and requiring shutdown when 4 or more cow/calf pairs enter that zone, were considered and required for this survey.

Comment 16: Stating that airgun noise can cause direct injury to marine mammals, Dr. Bain points out that (1) "airgun arrays do not project noise equally in all directions," and that "beams formed by the arrays can cause an animal moving from high exposure toward lower exposure to move toward the travel path of the seismic survey vessel, ultimately resulting in higher exposure;" (2) "the flight path of animals moving away is not always optimal. Animals may begin by swimming directly away from the array. However, if the array is moving toward them at faster than their sustained swimming speed, the array will approach them. After a while, animals may change tactics to moving orthogonal to the direction of array movement. While orthogonal movement will ultimately reduce the maximum noise level experienced, it allows the seismic survey vessel to close on their location faster. Shortly before the animals are orthogonal to the survey vessel, they may turn and head in the opposite direction of the survey vessel, briefly approaching it, but then increasing the distance between them at close to the highest possible rate;" (3) if pinnipeds do not move away, "the seismic survey vessel can approach them," that "orienting behavior is interrupted with occasional swimming behavior. While the swims can increase the distance between the pinniped and the vessels track line, submerging exposes the ears to the full intensity of the received pulses"; (4) marine mammals may tolerate injury while feeding, because "[f]ishers and NMFS personnel have shot animals and used seal bombs to inflict pain in unsuccessful efforts to deter depredation," and that "predators sometimes swallow hooks along with their prey."

Response: While NMFS recognizes that intense noise exposure can cause direct harm to marine mammals, as discussed in the **Federal Register** for the proposed IHA (75 FR 32379; June 8, 2010) and in this document, the intensities of received levels need to be significantly higher or the exposure duration be significantly longer than those at issue here to cause TTS, let alone injury. Please refer to these documents and the EA for a detailed discussion on the noise impacts to marine mammals. The points Dr. Bain made in his comment do not support his argument. Regarding the first point, Dr. Bain is correct that airgun arrays do not project noise equally in all directions. As an airgun is designed to project its impulse downward, most of its acoustic energy is confined in downward beams. Although there is a significant amount of energy being propagated horizontally, especially close by, the intensity of noise is much less when compared to downward acoustic intensities. As acoustic energy travels from its source outwards, an animal moving from higher received levels to lower received levels is generally moving away from the source (the seismic airgun). At long distances where certain higher received levels form due to multi-path propagation and refraction, movement from higher received levels to lower received levels may not necessarily mean that the animal is moving away from the source. However, at this long distance, the received levels are expected to be much lower (below 160 dB) and the distances are expected to be far beyond the zone of influence. This response also addresses part of Dr. Bain's second point regarding animal movement. In addition, the seismic vessel is prohibited from approaching marine mammals within specific safety zones (180 dB isopleths at 2,500 m for cetaceans and 190 dB isopleths at 700 m for pinnipeds). Therefore, to address Dr. Bain's second and third points, regardless of whether animals are moving or not, the seismic vessel is not allowed to approach marine mammals within the designated safety zones. Finally, Dr. Bain's last point regarding the use of seal bombs to inflict pain and "predators sometimes swallow hooks along with their prey," is irrelevant to our MMPA findings for Statoil's seismic activities. Statoil's activities do not involve the use of seal bombs and there is no connection between predators swallowing hooks along with their prey and the use of seismic airguns.

Comment 17: Dr. Bain states that "[b]ubble formation may be caused by moderate levels of noise. Rectified diffusion (Crum and Mao 1996) and decompression sickness (Jepson *et al.* 2003) are two postulated mechanisms for this. In rectified diffusion, acoustic energy causes gas to diffuse from the blood into small bubbles. Since bubbles are smaller when compressed, and larger when rarified, the net diffusion is into the bubble, leading to bubble growth in blood, fat, or other tissues, to injurious size." He also states that behaviorally mediated decompression sickness is considered more likely than rectified diffusion as the cause of bubble formation (Cox *et al.* 2006).

Response: Although it has been suggested that bubble formation due to nitrogen gas bubble growth, resulting in effects similar to decompression sickness in humans (Jepson *et al.* 2003; Fernández *et al.* 2004, 2005), may be the cause for at least some of the beaked whale mass strandings that occurred in association with mid-frequency active sonar operations, the hypothesis remains untested and the acoustic causative mechanism remains unknown today. In addition, the pathway concerning nitrogen supersaturation levels for deep-diving species of interest, including beaked whales, are based on theoretical models (Houser *et al.* 2001; Southall *et al.* 2007), and no unequivocal support for any of the pathways presently exists.

Finally, the suspected bubble formation by acoustic sources, and the induced atypical diving pattern that are theorized to cause decompression sickness in deep diving marine mammals (such as beaked whales), were mostly speculated to be caused by tactical mid-frequency sonar associated with military exercises, not by airgun impulses from seismic surveys.

Comment 18: While discussing impacts specific to the Chukchi Sea, Dr. Bain states that displacement from feeding areas is an even greater concern for harbor porpoises. Dr. Bain adds his personal observations that due to their small size, going without food for a few days can be fatal to harbor porpoises; and that harbor porpoises in Juan de Fuca Strait and Haro Strait experienced a doubling of mortality rates following exposure to a series of mid-frequency sonar exercise.

Response: Dr. Bain did not provide any details to support his observations in the comments, and NMFS is not aware of any studies that support Dr. Bain's claim. Because there is no information showing that the doubling of mortality rate in harbor porpoises in Juan de Fuca Strait and Haro Strait is related to the mid-frequency sonar exercise, a causative relationship between the two cannot be derived.

As discussed previously, due to the limited area (531 km^2 for an area ensonified by received levels higher than 160 dB) that would be ensonified by the seismic airguns and the relatively short duration of the surveys (total of 60 days), and the constant movement of the

seismic vessel, it is unlikely that harbor porpoises or any other marine mammals would be displaced for any significant amount of time by the proposed open water seismic surveys. Therefore, even if marine mammals temporarily avoid an area that might be their feeding ground due to the seismic survey, the duration of the displacement is expected to be short, so that animals will not lose feeding opportunities for more than a few hours up to a day. In addition, the majority of sound sources from airgun arrays are in the low-frequency range, which is outside harbor porpoises' sensitive hearing range. Therefore, even though the intensities of seismic impulses are high, these impulses may not be perceived as intense noise by harbor porpoises due to their high-frequency hearing.

Comment 19: AEWC states that in assessing the level of take and whether it is negligible, NMFS relied on flawed density estimates that call into question all of NMFS' preliminary conclusions. AEWC states that density data are lacking or outdated for almost all marine mammals that may be affected by Statoil's operations in the Chukchi Sea. AEWC argues that NMFS' guess at the number of beluga and bowhead whales relies on a study from Moore *et al.* (2000), which was ten years old. AEWC says that the estimate is contrary to the best available scientific information on beluga whale presence in the Chukchi Sea. AEWC points out that the most recent Alaska Marine Mammal Stock Assessment dates from 2009 and was issued in February 2010 (Allen and Angliss 2010), but Statoil's IHA application relied on the 2008 Alaska Marine Mammal Stock Assessment (Angliss and Allen 2009). AEWC further states that Allen and Angliss (2010) likely underestimated the size of the eastern Chukchi Sea beluga whale stock.

AEWC also notes that the density of bowhead whales was derived from the same ten-year-old report (Moore *et al.* 2000) as was used to calculate beluga whale densities. AEWC points out that NMFS makes no mention of the most recent Alaska Marine Mammal Stock Assessment which was released this year, and that the Assessment cites to a 2003 study that documented bowheads "in the Chukchi and Bering Seas in the summer" that are "thought to be a part of the expanding Western Arctic stock" (Allen and Angliss 2010). While a study published in 2003 still is not a sufficient basis for a 2009 density analysis, this study does show that additional information is available that indicates that the number of bowhead whales in the Chukchi may be higher than estimated by NMFS. NSB also points out that Statoil references aerial surveys conducted by Shell and ConocoPhilips between 2006 and 2008 occurred exclusively in nearshore areas and not within Statoil's proposed operation area.

Response: As required by the MMPA implementing regulations at 50 CFR 216.102(a), NMFS has used the best scientific information available in assessing the level of take and whether the take by harassment will have a negligible impact on affect species or stocks. As far as the best scientific information is concerned, NMFS still considers Moore et al. (2000) to provide the best density estimate for the eastern Chukchi Sea population of beluga whales. The Alaska Marine Mammal Stock Assessment reports (Angliss and Allen 2009; Allen and Angliss 2010) do not report density estimates of the beluga whale population, they provide population estimates of marine mammal species and stocks. Furthermore, for the eastern Chukchi Sea stock of beluga whales, Allen and Angliss (2010) and Angliss and Allen (2009) provide the same average estimates of 3,710 individuals, therefore, even though Statoil used an earlier version of the Alaska Marine Mammal Stock Assessment Report, its number is the same as the 2010 report.

Similarly, the Alaska Marine Mammal Stock Assessment only reports the abundance and population size, it does not provide density estimates of marine mammals in the proposed project area. The 2003 study noted by AEWC in the bowhead whale Alaska Marine Mammal SAR discusses distribution, not density (Rugh *et al.* 2003). It was not cited because it is not useful for deriving density estimates. Therefore, density estimates for bowhead and beluga whales using Moore *et al.* (2000) are based on the best available science.

Although most data used for marine mammal density are from Moore *et al.* (2000), information from other sources, wherever available, such as aerial surveys conducted by Shell and ConocoPhilips between 2006 and 2008 (Haley *et al.* 2009), were also used to fill data gaps.

Comment 20: AEWC states that NMFS fails to explain how and why it reaches various conclusions in calculating marine mammal densities and what the densities are actually estimated to be once calculated. One example is NMFS' reliance on Moore *et al.* (2000) in making its density determinations. This study documented sightings of marine mammals but did not estimate the total number of animals present. AEWC states that NMFS's practices have resulted in entirely arbitrary calculations of the level of take of marine mammals and whether such takes constitute "small numbers" or a "negligible impact" as a result of Statoil's proposal.

Response: All densities used in calculating estimated take of marine mammals based on the described operations are shown in Tables 2 and 3 of Statoil's application. Moore *et al.* (2000) provides line transect effort and sightings from aerial surveys for cetaceans in the Chukchi Sea. Species specific correction factors for animals that were not at the surface or that were at the surface but were not sighted [g(0)] and animals not sighted due to distance from the survey trackline [f(0)] used in the equation were taken from reports or publications on the same species or similar species (if no values were available for a given species) that used the same survey platform. Additional explanations regarding the calculations of marine mammal densities are provided in Statoil's application and the **Federal Register** notice for the proposed IHA (75 FR 32379; June 8, 2010). Therefore, NMFS believes the methodology used in take calculations of the level of take of marine mammals is scientifically well supported.

Comment 21: AEWC is opposed to NMFS using "survey data" gathered by industry while engaging in oil and gas related activities and efforts to document their take of marine mammals. AEWC points out that such industry "monitoring" is designed to document the level of take occurring from the operation (see 75 FR 32379 and Statoil's 4MP). AEWC argues that putting aside whether the methodologies employed are adequate for this purpose, they certainly are not adequate for assessing the density or presence of marine mammals that typically avoid such operations.

Response: In making its determinations, NMFS uses the best scientific information available, as required by the MMPA implementing regulations. For some species, density estimates from sightings surveys, as well as from "industry surveys", were provided in the text of Statoil's application and the Notice of Proposed IHA for purposes of comparison. However, where information was available from sightings surveys (e.g., Moore *et al.* 2000; Bengtson *et al.* 2005), those estimates were used to calculate take. Data collected on industry vessels were only used when no other information was available. Additionally, while some Arctic marine mammal species have shown fleeing responses to seismic airguns, data is also collected on

these vessels during periods when no active seismic data collection is occurring.

Comment 22: AEWC states that as a general matter, when it comes to NMFS assessing the various stocks of marine mammals under the MMPA, it cannot use outdated data i.e., "abundance estimates older than 8 years" because of the "decline in confidence in the reliability of an aged abundance estimate" (Angliss and Allen 2009) and the agency is thus unable to reach certain conclusions. Similarly, here, where data are outdated or nonexistent, NMFS should decide it cannot reach the necessary determinations. AEWC argues that these flaws in NMFS' analysis render the agency's preliminary determinations about the level of harassment and negligible impacts completely arbitrary.

Response: The statements quoted by AEWC from Angliss and Allen (2009) are contained in species SARs where abundance estimates are older than 8 years. However, the full statement reads as follows: "However, the 2005 revisions to the SAR guidelines (NMFS 2005) state that abundance estimates older than 8 years should not be used to calculate PBR due to a decline in confidence in the reliability of an aged abundance estimate." Statoil's activities are not anticipated to remove any individuals from the stock or population. Therefore, a recent estimate of PBR is not needed for NMFS to make the necessary findings under Section 101(a)(5)(D) of the MMPA. Additionally, Statoil's application provides information (including data limitations) and references for its estimates of marine mammal abundance. Because AEWC has not provided information contrary to the data provided by Statoil, and NMFS does not have information that these estimates are not reliable, NMFS considers these data to be the best available.

Comment 23: Dr. Bain states that standard terminology in the field of density estimates is not used in density estimates, specifically citing the use of f(0). Dr. Bain recommends that an f(0) should be calculated from the data when there is a reference to 891 "transect" sightings of bowheads and that these sightings should have been used in Distance to calculate an f(0) for bowheads and states that it is reasonable to assume this has already been done. Dr. Bain states that log-normal confidence limits should be used when calculating the densities and that the upper confidence limits should be used as the point estimate in the take calculations. Dr. Bain recommends that double-platform trials should be run in Distance to better estimate g(0).

Response: The traditional f(0) parameter and terminology are used throughout the density estimate descriptions in Statoil's application.

However, there is no reference given for the 891 "transect" sightings which would allow an evaluation of whether or not the associated covariates suggested by Dr. Bain are available for the recommended analysis. Also, Dr. Bain did not provide a reference for the results of such an analysis that he suggests are reasonable to assume exist.

The equations for the calculation of log-normal confidence limits are provided and an example using "three point estimates of summertime density of bowhead whales" is shown. However, there is no indication of where the three point estimates of summertime densities came from and values in the application do not combine to replicate the estimate provided. Using the upper confidence limits of an estimate is an extremely conservative approach on top of already conservative assumptions regarding received sound levels. Maximum densities and associate take estimates provided in the application are meant to provide upper estimates similar to those suggested from using the upper confidence limits. Basing decisions on take estimates from the upper confidence limits is, as Dr. Bain points out, extremely precautionary, and NMFS does not believe it represents the best available scientific approach.

Since no reference is given for such double-platform data on bowheads. NMFS is not aware of the existence or availability of sufficient data from double-platform trials while surveying bowheads to do the recommended analysis. Collection of an adequate dataset would likely require multiple years of aerial surveys using two observers on each side of the aircraft that collect data independently of each other, which is impracticable due to the scope and scale of the research. Nevertheless, based on available data and analysis, NMFS believes that existing datasets are adequate to address the degrees and levels of potential impacts to marine mammals as a result of the proposed seismic surveys in the project vicinity.

Comment 24: Dr. Bain points out that use of the statistical method for incorporating uncertainties is trivial. He further states that the data were inappropriately split to estimate densities and that the raw data should have been analyzed using multivariate modeling approaches available in Distance.

Response: As suggested by Dr. Bain, incorporating uncertainty associated with various parameters in a density estimate is relatively easier when working with actual raw survey data by using the Distance software. However, data or analyses of the type suggested on the relevant species at the location and time of the proposed project are not available. Estimates of uncertainty are not necessarily available for all parameters found in the literature that were used to calculate estimated densities. Although incorporating all parameters and associated uncertainties into a single framework would indeed be a good approach, it would not be practical for an applicant to conduct analyses in such detail and large scale. As stated earlier, NMFS believes that existing datasets are adequate to address the degrees and levels of potential impacts to marine mammals as a result of the proposed seismic surveys in the project vicinity.

As for the final point, data "splits" used in the application were based on a published article and the necessary data to do the analysis as Dr. Bain suggested using Distance are not available.

Comment 25: Commenting on Southall *et al.* (2007), Dr. Bain states that Southall *et al.'s* review relied on published reports, and they were selective for datasets reported in a way that fit their categorization scheme. Dr. Bain points out that other workers have access to raw data and can rescore behavioral responses using Southall *et al.'s* system (*e.g.,* Bain and Williams in review). Dr. Bain further states that he found that the approach of generalizing responsiveness based on morphological group, such as pinnipeds, high-frequency hearing specialists (small odontocetes), low-frequency specialists (mysticetes), etc., unlikely to be valid, as sibling species such as Dall's and harbor porpoises differed dramatically in their responses to noise from the same airguns in the same geographic area, and harbor porpoises appeared more responsive to airguns than low-frequency specialists like gray whales.

Response: NMFS does not agree with Dr. Bain's assessment on Southall *et al.'s* review. First, the central purpose of the Southall *et al.* (2007) paper is to propose, for various marine mammal groups and sound types, levels above which there is a scientific basis for expecting that exposure would cause auditory injury to occur. Although behavioral or electrophysiological audiograms only exist for approximately 20 marine mammal species (of ~128 species and subspecies; Rice 1998), however, since physiological effects of

the auditory structure, *i.e.,* TTS or PTS, are closely related to the frequency ranges of acoustic signals that are sensitive to a particular audio-physiology mechanism, by combining audiograms of known marine mammal species with comparative anatomy, modeling, and response measured in ear tissues from species that are difficult to study, it is a valid approach to classify marine mammal hearing based on their functional hearing groups. Although the current classification of five functional hearing groups (*i.e.,* low-frequency cetacean, mid-frequency cetacean, high-frequency cetacean, pinnipeds in water, and pinnipeds in air) is still in its initial stage, and further improvements are no doubt needed as more scientific information becomes available, these improvements are likely to be focusing on refining the current groupings (*e.g.,* dividing pinnipeds into otariids and phocids). NMFS considers the use of these functional hearing groups in addressing physiological effects and hearing impairment a valid approach.

Second, as far as behavioral effects are concerned, Southall *et al.* (2007) admits that "the available data on behavioral responses do not converge on specific exposure conditions resulting in particular reactions, nor do they point to a common behavioral mechanism." They further points out that "[i]t is clear that behavioral responses are strongly affected by the context of exposure and by the animal's experience, motivation, and conditioning." Therefore, behavioral responses to external stimuli may not be able to be addressed just based on received levels. For example, in Bain and Williams (in review) it is stated that Dall's porpoises were "observed at received levels up to approximately 180 dB re 1 µPa p-p," while harbor porpoises were "recorded at received levels up to 155 dB re 1 µPa p-p, and all individuals were moving away at this level," it is possible that a major factor causing the harbor porpoises to move away was the researchers' vessel that was closely approaching the animals at approximately 20 km/h. We believe a more rigorously designed controlled exposure experiment or behavioral response study is required to obtain unbiased data to address behavioral responses of marine mammals to anthropogenic sound. For this reason, studies used in the Southall *et al.* (2007) review were carefully selected to include studies where "noise exposure (including source and received levels, frequency, duration, duty cycle, and other factors) was either directly reported or was reasonably estimated using simple sound propagation models deemed appropriate for the sources and operational environment" (Southall *et al.* 2007).

Nevertheless, for regulatory purposes, NMFS has been using 160 dB re 1 µPa (rms) as the onset for behavioral harassment when exposed by impulse sources. The basis for choosing received levels corresponding to the onset of behavioral harassment came from many field observations and analyses (*see* review by Richardson *et al.* 1995; Southall *et al.* 2007) that NMFS considers representative in many situations.

Comment 26: Dr. Bain states that changes in behavior resulting from noise exposure could lead to injury or death through a number of mechanisms, and he gave the example that "hearing loss due to PTS or TTS may prevent animals from detecting approaching vessels, leading to collisions between marine mammals and vessels," and that such collisions are often ultimately fatal, and that hearing loss may also lead to entanglement and increased risk of predation. Dr. Bain states that hearing ability can also be impaired during exposure to low levels of noise, causing masking. Dr. Bain also points out that another behavioral response to noise is flight, and that "flight can result in stranding (NOAA and Navy 2001), or extreme exhaustion resulting in muscle damage or heart failure (Williams and Thorne 1996)."

Response: NMFS agrees that it is possible that changes in behavior or auditory masking resulting from noise exposure could lead to injury in marine mammals under certain circumstances, such as the hypothesized atypical diving patterns that may be exhibited by beaked whales when exposed to military tactical mid-frequency sonar, as discussed earlier and in NOAA and Navy (2001) cited by Dr. Bain in his comment. However, in most cases, changes in behavior resulting from noise exposure do not lead to PTS or TTS as apparently assumed by Dr. Bain in his comment. Additionally, as discussed in the **Federal Register** notice for the proposed IHA and in this document, marine mammals exposed to the proposed Statoil seismic surveys are not expected to experience TTS or PTS with the implementation of appropriate monitoring and mitigation measures. Furthermore, the assumption that Dr. Bain made that "exhaustion from rapid flight leading to heart or other muscle damage" could account for mortality merely because of exposure to airgun noise has no scientific basis.

For issues regarding behavioral change and masking by the proposed Statoil seismic surveys, NMFS does not believe that received SPLs from the airgun arrays would cause drastic changes in behavior or auditory masking in marine mammals outside the safety zones. Unlike military sonar, seismic pulses have an extremely short duration (tens to hundreds of milliseconds) and relatively long intervals (several seconds) between pulses. Therefore, the sound energy levels from these acoustic sources and small airguns are far lower in a given time period. Second, the intervals between each short pulse would allow the animals to detect any biologically significant signals, and thus avoid or prevent auditory masking. Although airgun pulses at long distances (over kilometers) may be "stretched" in duration and become non-pulse due to multipath propagation, the intervals between the non-pulse noises would still allow biologically important signals to be detected by marine mammals. In addition, NMFS requires mitigation measures to ramp-up acoustic sources at a rate of no more than 6 dB per 5 min. This ramp-up would prevent marine mammals from being exposed to high levels of noise without warning, thereby eliminating the possibility that animals would dramatically alter their behavior (i.e. from a "startle" reaction).

Comment 27: Citing research on long term adverse effects to whales and dolphins from whale watching activities (Trites and Bain 2000; Bain 2002; Lusseau *et al.* 2009), Dr. Bain states that Level B behavioral harassment could be the primary threat to cetacean populations.

Response: Although NMFS agrees that long-term, persistent, and chronic exposure to Level B harassment could have a profound and significant impact on marine mammal populations, such as described in the references cited by Dr. Bain, those examples do not reflect the impacts of seismic surveys to marine mammals for Statoil's project. First, whale watching vessels are intentionally targeting and making close approaches to cetacean species so the tourists onboard can have a better view of the animals. Some of these whale/dolphin watching examples cited by Dr. Bain occurred in the coastal waters of the Northwest Pacific between April and October and for extended periods of time ("[r]ecreational and scientific whale watchers were active by around 6 a.m., and some commercial whale watching continued until around sunset"). Thus multiple vessels have been documented to be in relatively close proximity to whales for about 12 hours a day, six months a year, not counting some "out of season" whale

watching activities and after dark commercial filming efforts. In addition, noise exposures to whales and dolphins from whale watching vessels are probably significant due to the vessels' proximity to the animals. To the contrary, Statoil's proposed seismic survey, along with existing industrial operations in the Arctic Ocean, does not intentionally approach marine mammals in the project areas. Statoil's survey locations are situated in a much larger Arctic Ocean Basin, which is far away from most human impacts. Therefore, the effects from each activity are remote and spread farther apart, as analyzed in NMFS' 2010 EA, as well as the MMS 2006 PEA. Statoil's seismic activities would only be conducted between late July and October for about 60 days, weather permitting. In addition, although studies and monitoring reports from previous seismic surveys have detected Level B harassment of marine mammals, such as avoidance of certain areas by bowhead and beluga whales during the airgun firing, no evidence suggests that such behavioral modification is biologically significant or non-negligible (Malme *et al.* 1986; 1988; Richardson *et al.* 1987; 1999; Miller *et al.* 1999; 2005), as compared to marine mammals exposed to chronic sound from whale watching vessels, as cited by Dr. Bain. Therefore, NMFS believes that potential impacts to marine mammals in the Chukchi Sea by seismic surveys would be limited to Level B harassment only, and due to the limited scale and remoteness of the project in relation to a large area, such adverse effects would not accumulate to the point where biologically significant effects would be realized.

Comment 28: Dr. Bain notes that NMFS uses different thresholds for continuous and pulsed sounds, and that "NMFS based its use of a 120 dB contour for continuous sounds primarily on studies of bowheads and gray whales." Dr. Bain observes that "these studies were conducted based on whales close to noise sources," and the "120 dB contour was commonly the level at which 50% of the animals exposed to noise showed observable changes in behavior, such as deflection of the travel path away from the source." Dr. Bain states that there are two problems with this interpretation of the data: (1) This implies that 50% of the whales observed responded to levels lower than 120 dB. That is, 120 dB is not a threshold for a species but a median value of thresholds of individuals. The likelihood that individuals will be taken by exposure to noise levels below 120 dB declines with received level, but does not approach 0 until the received level approaches the limit of audibility; and (2) individuals that responded to levels much lower than 120 dB were not included in these studies, as they did not approach close enough to be observed. NSB also states that bowhead whales showed almost total avoidance of an area around seismic surveys where received sound levels were greater than 120 dB (LGL Ltd. and Greenridge Sciences 1999), and that since the ensonified area for 120 dB is huge, the entire bowhead population could be affected.

Response: Since Dr. Bain did not provide any reference in his comment, the validity of his notes and observation cannot be verified. However, NMFS is not aware of the "use of a 120 dB contour for continuous sounds" on any marine mammal species. The basis for choosing received levels corresponding to the onset of behavioral harassment came from many field observations and analyses (*see* review by Richardson *et al.* 1995; Southall *et al.* 2007) on measured avoidance responses in whales in the wild. It is also important to know that NMFS uses different received levels for behavioral harassment caused by impulse and non-impulse noises (i.e., received level at 160 dB re 1 µPa for impulse and 120 dB re 1 µPa for non-impulse). To be specific, the 160 dB re 1 µPa (rms) threshold was derived from data for mother-calf pairs of migrating gray whales (Malme *et al.* 1983; 1984) and bowhead whales (Richardson *et al.* 1985; Richardson *et al.* 1986) responding when exposed to seismic airguns (impulsive sound source). The 120 dB re 1 µPa (rms) threshold also originates from research on baleen whales, specifically migrating gray whales (Malme *et al.* 1984; predicted 50% probability of avoidance) and bowhead whales reacting when exposed to industrial (i.e., drilling and dredging) activities (non-impulsive sound source) (Richardson *et al.* 1990).

Second, Dr. Bain confused "take" under the MMPA with any observed behavioral response. A "take" by Level B harassment is defined as "any act of pursuit, torment, or annoyance which * * * has the potential to disturb a marine mammal or marine mammal stock in the wild by *causing disruption of behavioral patterns,* including, but not limited to, migration, breathing, nursing, breeding, feeding, or sheltering" (emphasis added). A brief startling response without subsequent change of the animal's ongoing behavioral pattern, for example, does not constitute a "take" under the definition of MMPA. Therefore, marine mammals that briefly respond to certain received noise levels may not be "taken," as long as there is no disruption of their behavioral patterns.

Finally, as stated above, received levels at 160 dB re 1 µPa is currently used by NMFS as the onset of behavioral harassment for impulses, and source characteristics from airgun arrays are classified as impulses. Therefore, the 120 dB continuous noise discussion in Dr. Bain's comment is inapplicable.

Comment 29: Citing works by Calambokidis *et al.* (1998) and Bain and Williams (in review) on impacts of marine mammal behavioral by seismic surveys, Dr. Bain states that harbor porpoises are more likely to be affected by lower received levels than other cetaceans. Dr. Bain states that he believes "the segregation of population by noise tolerance (and physical ability to avoid the noise source) provides an explanation for why some studies detect marine mammals close to noise sources, and other show responses to received levels in the neighborhood of 90 dB or less at great distance." Dr. Bain further states that future work will be needed to elucidate nuances of how those probabilities are influenced by non-noise factors such as location, activity state, or individual factors like age, sex, reproductive status, health status, group composition, and previous experience with noise exposure. Dr. Bain concludes that "bowhead and gray whales can be expected to respond out to the 120 dB contour, with more sensitive individuals perhaps responding at the 105 dB contour. Killer whales and belugas would be expected to respond at the 105 dB contour, with the need for social cohesion resulting in less variability in response than seen in bowheads and grays. Harbor porpoises are likely to exhibit responses out to the level of detection, as they have been shown to respond to received noise below 90 dB in quiet water."

Response: NMFS agrees that behavioral responses by marine mammals to noise sources vary with species, population, behavioral context, age, sex, and source characteristics, etc., and NMFS has been looking into these factors and is supporting research such as behavioral response studies (BRS) at the Atlantic Undersea Test and Evaluation Center (AUTEC) in the Bahamas, the Mediterranean Sea, and off southern California to elucidate factors that could induce behavioral responses on cetaceans by various noise sources, particularly by military sonar. Nevertheless, at the current stage, as stated above, NMFS still uses the 120 dB and 160 dB re 1 µPa as the threshold for the onset of behavioral harassment

for non-impulse and impulse noise sources, respectively. Based on many field studies and observations (*see* review by Richardson *et al.* 1995; Southall *et al.* 2007), NMFS believes that these thresholds are conservative and can provide relatively fair estimates of marine mammals potentially subject to harassment.

Dr. Bain did not provide any reference to support his claim that "bowhead and gray whales can be expected to respond out to the 120 dB contour, with more sensitive individuals perhaps responding at the 105 dB contour. Killer whales and belugas would be expected to respond at the 105 dB contour, with the need for social cohesion resulting in less variability in response than seen in bowheads and grays. Harbor porpoises are likely to exhibit responses out to the level of detection, as they have been shown to respond to received noise below 90 dB in quiet water." Additionally, Dr. Bain did not provide what these responses are and whether they meet the definition of "takes" under the MMPA.

Comment 30: Citing his manuscript (Bain and Williams, in review) on effects of large airgun arrays on the behavior of marine mammals at long distances in the waters of British Columbia, Canada and Washington State, USA, Dr. Bain argues that marine mammals can be taken at much lower received levels, and states that NMFS underestimated take numbers of marine mammals.

Response: NMFS reviewed Dr. Bain's attached manuscript (Bain and Williams, in review), which was attached with his comments. The paper examines the effects of large airgun arrays on behavior of marine mammals in the waters of British Columbia, Canada and Washington State, USA, using a small boat to monitor out to long ranges (1 to > 70 km from the seismic source vessel), and contains some information concerning marine mammals that were apparently affected by the seismic survey. The paper, which was originally presented at the IWC meeting in 2006, concludes that a significant relationship was observed between the magnitude of behavioral response and peak-to-peak received level and the long distances at which behavioral responses were observed (≤ 60 km for harbor porpoise), along with counter-productive behavior that occasionally brought individuals into higher-intensity acoustic zones. However, there are potential design flaws in this study. First, the paper states a launch carried aboard the seismic receiver vessel was placed in the water to perform received level measurements near marine mammals. When making acoustic measurements, the launch "travelled along a line at approximately 20 km/h until either marine mammals were closely approached, or the launch had travelled 10 km." Therefore, it is highly likely that behavioral reactions from observed marine mammals were caused by the high-speed, close-approach of the launch, rather than from distant seismic airguns. This experiment design may explain the authors' observation of "counter-productive behavioral responses" that animals are moving into higher-intensity acoustic zones, which probably indicates that behavioral changes caused by Bain's launch greatly exceeded any behavioral change resulting from exposure to seismic airgun noise. Second, the authors of the paper also expressed "methodological concerns due to the subjectivity of observers." Nevertheless, this study (Bain and Williams, in review) concludes that harbor seal individuals were generally moving away from the airguns at exposure levels above 170 dB re 1 μPa (p-p) and that gray whales were observed at received levels up to approximately 170 dB re 1 μPa (p-p) exhibiting no obvious behavioral response. These observations contradict Mr. Bain's earlier comments that major behavioral effects result from noise in the 105—125 dB range.

Finally, Bain and Williams (in review) also state that the study "found that while airguns concentrated their sound output at low frequencies, substantial high frequency energy (to at least 100 kHz) was also present." However, the paper provides no explanation as to how this conclusion was made. The accompanying power density spectrum (Figure 2 in Bain and Williams, in review) of the paper fails to show evidence that the frequencies above 1 kHz were mostly contributed from seismic airguns, and there was no indication at what distance this recording was made. Therefore, Bain and Williams (in review) cannot be used to interpret marine mammal behavioral reactions to long distance seismic sources because it fails to provide a valid argument that the behavioral reactions by observed marine mammals are from seismic noises and that the acoustic energy of the recorded broadband received levels (up to 100 kHz) is entirely from seismic airguns.

Comment 31: Stating marine mammal takes could occur at received levels at 90 dB, Dr. Bain claims that he used the applicant's equation of RL = 157.2 − 35.3 LOG (R/10000) − 0.0000064 (R − 10000) to estimate the distance to the 135 dB, 120 dB, 105 dB, and 90 dB contours, and showed that the best fit distances of these isopleths to be 42000, 110000, 270000, and 620000 (no units given), respectively, with relative areas at 10, 72, 431, and 2274 (no units given), respectively; the 90th percentile distances of these isopleths to be 45000, 116000, 285000, and 650000 (no units given), respectively, and the relative areas of these isopleths to be 12, 80, 311, and 2500 (no units given), respectively. In comparison, Statoil's estimated received level at 120–dB isopleths is 70–120 km from the source (75 FR 32379; June 8, 2010).

Response: First, Statoil did not use the equation in Dr. Bain's comment for the estimates of distances to safety zones (180-dB and 190-dB re 1 μPa for cetaceans and pinnipeds, respectively) and zone of influence (160-dB re 1 μPa isopleths). As stated in Statoil's IHA application and in the **Federal Register** notice for the proposed IHA (75 FR 32379; June 8, 2010), the basis for the estimation of distances to the four received sound levels (190 dB, 180 dB, 160 dB, and 120 dB re 1 μPa) from the proposed 3000 in^3 airgun array operating at a depth of 20 ft (6 m) are the 2006, 2007 and 2008 sound source verification (SSV) measurements in the Chukchi Sea of a similar array, towed at a similar depth. The measured airgun array had a total discharge volume of 3,147 in^3 and was composed of three identically-tuned Bolt airgun sub-arrays, totaling 24 airguns (6 clusters of 2 airguns and 12 single airguns). The proposed 3,000 in^3 array is also composed of three strings with a total of 26 active airguns in 13 clusters (five clusters of 10 airguns are inactive and will be used as spares). The difference in discharge volume would lead to an expected loss of less than 0.2 dB and is neglected in this assessment. The estimated source level for the full 3,000 in^3 array is 245 dB re 1 μPa (rms). Before SSV tests could be conducted for the 3,000 in^3 array that would be used for the proposed seismic survey, it is reasonable to adopt the maximum distances obtained from a similar array during previous measurements in the Chukchi Sea. Therefore, the distances to received levels of 190, 180 160, and 120 dB re 1 μPa (rms) are conservatively estimated at 700, 2,500, 13,000, and 70,000–120,000 m, respectively. The only propagation equation Statoil used in estimating the zones of different isopleths is the one used to calculate the safety zones and zone of influence for the 60 in^3 mitigation gun, which was adjusted by adding 3 dB. The term of the equation is:

RL = 226.6 − 21.2log(R) − 0.00022R,
where R is distance in m.

Second, based on the equation Dr. Bain provided, NMFS calculated the distances to 190 and 180-dB received levels at 1,180 m and 2,260 m, respectively, which are very different from what Dr. Bain reported at 370 and 1,100 (units not given), respectively, for "best fit", and 450 and 1,400 (units not given), respectively, for "90th percentile." Finally, without field measurements, NMFS does not know, and Dr. Bain did not explain, how the "best fit" and "90th percentile" were calculated.

Comment 32: Dr. Bain states that recent declines in gray whale populations have resulted in the population dropping below the level at which they were delisted, and that emaciation has been observed in many gray whales that have stranded this year, so exclusion from potential feeding grounds is of extra concern this year. Further, Dr. Bain states that harbor porpoises can be affected at large distances from noise sources, and hence large numbers would be expected to be affected by this and other activities. He points out that although NMFS currently recognizes only a single, large stock whose range includes the project area, genetic and movement studies in other parts of the harbor porpoise range have shown that stocks tend to be much smaller and have limited ranges. Finally, Dr. Bain points out that cumulative effects on belugas and other species are likely to have been underestimated because the "greater range at which they are likely to be affected and the potential for greater overlap between the project activities and migration through the area than considered by NMFS for this and the shallow water survey make this the case."

Response: Systematic counts of Eastern Pacific gray whales migrating south along the central California coast have been conducted by shore-based observers at Granite Canyon most years since 1967. The most recent abundance estimates are based on counts made during the 1997–98, 2000–01, and 2001–02 southbound migrations. Analyses of these data resulted in abundance estimates of 29,758 for 1997–98, 19,448 for 2000–01, and 18,178 for 2001–02 (Rugh *et al.* 2005). NMFS is aware of the 2000–01 and 2001–02 population drops in the gray whales, nevertheless, to a certain degree, variations in estimates may be due in part to undocumented sampling variation or to differences in the proportion of the gray whale stock migrating as far as the central California coast each year (Hobbs and Rugh 1999). The decline in the 2000–01 and 2001–02 abundance estimates may be an indication that the abundance was responding to environmental limitations as the population approaches the carrying capacity of its environment (Allen and Angliss 2010). Low encounter rates in 2000–01 and 2001–02 may have been due to an unusually high number of whales that did not migrate as far south as Granite Canyon or the abundance may have actually declined following high mortality rates observed in 1999 and 2000 (Gulland *et al.* 2005). Visibly emaciated whales (LeBoeuf *et al.* 2000; Moore *et al.* 2001) suggest a decline in food resources, perhaps associated with unusually high sea temperatures in 1997 (Minobe 2002). Several factors since this mortality event suggest that the high mortality rate was a short-term, acute event and not a chronic situation or trend: (1) Counts of stranded dead gray whales dropped to levels below those seen prior to this event, (2) in 2001 living whales no longer appeared to be emaciated, and (3) calf counts in 2001–02, a year after the event ended, were similar to averages for previous years (Rugh *et al.* 2005). Though it is impractical to exclude the proposed Statoil seismic survey entirely from the gray whale feeding areas (such as areas near Hanna Shoal), as discussed in the **Federal Register** notice for the proposed IHA (75 FR 32379; June 8, 2010) and in this document, the potential impacts to gray whales (and other marine mammals) is expected to be negligible. In addition, mitigation and monitoring measures described below would further reduce the potential impacts. Lastly, Statoil's surveys are not expected to destroy or result in any permanent impact on habitats used by gray whales or to their prey resources or to jeopardize the continued existence of the species.

Since delisting gray whales in 1994, NMFS has continued to monitor the status of the population consistent with its responsibilities under the ESA and the MMPA. In 1999, a NMFS review of the status of the eastern North Pacific stock of gray whales recommended the continuation of this stock's classification as nonthreatened (Rugh *et al.* 1999). Workshop participants determined the stock was not in danger of extinction, nor was it likely to become so in the foreseeable future. In 2001 several organizations and individuals petitioned NMFS to re-list the eastern North Pacific gray whale population. NMFS concluded that there were several factors that may be affecting the gray whale population but there was no information indicating that the population may be in danger of extinction or likely to become so in the foreseeable future. Wade and Perryman (2002) and Punt *et al.* (2004) (cited in the 2008 SAR, Angliss and Allen 2009) found that the stock is within its optimum sustainable population level and that the population is likely close to or above its unexploited equilibrium level. NMFS continues to monitor the abundance of the stock through the MMPA stock assessment process, especially as it approaches its carrying capacity. If new information suggests a reevaluation of the eastern North Pacific gray whales' listing status is warranted, NMFS will complete the appropriate reviews.

Without scientific support, NMFS does not agree with Dr. Bain's assumption that "harbor porpoises can be affected at large distances from noise sources, and hence large numbers would be expected to be affected by this and other activities." Due to the lack of robust field studies and observations, behavioral responses of harbor porpoises (a species in the "high-frequency cetacean" functional hearing group) to impulse noise sources such as those generated by airguns are poorly known. Given that they are high-frequency cetaceans, harbor porpoises are not considered to be sensitive to low frequency noise sources when compared to bowhead whales (which are "low-frequency cetaceans" species). However, NMFS currently uses 160 dB re 1 μPa (rms) as the threshold for the onset of behavioral harassment for all marine mammals. Therefore, NMFS believes its method for calculating takes of harbor porpoises using 160 dB re 1 μPa (rms) is reasonable.

Whether harbor porpoises occurring in Alaska waters belong to one single, large stock is still under scientific debate. Nevertheless, at this time, no data are available to reflect stock structure for harbor porpoise in Alaska, and for management purposes, NMFS Alaska Marine Mammal Stock Assessment reports consider only one Alaska stock of harbor porpoise (Allen and Angliss 2010). Should new information on harbor porpoise stocks become available, the harbor porpoise Stock Assessment Reports will be updated.

Finally, cumulative effects on beluga whales and other species are analyzed in NMFS 2010 EA for the proposed Shell and Statoil's marine and seismic surveys in the Beaufort and Chukchi Seas. The take calculation, which takes into considerations of seasonal and spatial distributions of marine mammals

in the proposed survey areas, is provided in Statoil's IHA application and in the **Federal Register** notice for the proposed IHA (75 FR 32379; June 8, 2010) and in this document.

Comment 33: Dr. Bain states that humpback whales are endangered and the stock inhabiting Northern Alaska has a small PBR. Due to uncertainty over the exact amount of human-caused mortality, it is unknown whether ongoing human-caused mortality exceeds potential biological removal (PBR). Although humpback use of the project area is likely to be minimal, any impact on humpbacks poses threats at both the individual and population level. The story is the same for fin whales, except that ongoing human-caused mortality is believed to be near zero if one does not consider ship strikes. Dr. Bain further states that the PBR for the Eastern Chukchi beluga stock is undetermined, because no recent population data are available. If PBR were estimated from old data, it would be 74; with an average annual subsistence harvest of 59, this leaves 15 individuals for other human-caused mortality, which is smaller than many aggregations of belugas. That is, if seismic surveys had lethal effects on a single group of belugas, it could put human-caused mortality over PBR. Finally, Dr. Bain states that killer whales have been observed in the project area, but the stock(s) present is unknown. They are most likely members of the Gulf of Alaska, Aleutian Islands, and Bering Sea Transient Stock, which has a PBR of 3.1, some of which is caused by fishery interactions. A little less likely to be present are members of the Eastern North Pacific Alaska Resident Stock, which has a PBR of 11.2, with an existing human-caused mortality of 1.5 per year. For members of either stock, lethal effects of noise to a single group would exceed PBR.

Response: Regarding humpback, fin, and killer whales, their occurrence in the proposed project area is rare, and NMFS take estimates show that only 2 individuals of each of these species would be taken by Level B behavioral harassment as a result of the proposed Statoil seismic survey in the Chukchi Sea. Although a total of 184 Eastern Chukchi Sea beluga whales are estimated to be taken by Level B behavioral harassment, these numbers represent less than 5 percent of the total Eastern Chukchi Sea beluga whales population. As mentioned in the **Federal Register** notice (75 FR 32379; June 8, 2010) and in this document, no takes by Level A harassment (injury) and death are expected or authorized for the proposed seismic activities. Therefore, the discussion of PBR is inapplicable to this action.

Comment 34: AWL notes that Statoil's closely spaced survey lines and large cross-track distances will result in the "repeated exposure of the same area of waters." AWL further states that although the area of overlap for 160-dB does not directly apply to the smaller 180- and 190-dB safety zones, the logic employed does reveal the potential for non-migratory species to encounter Statoil's surveying a number of times over its duration, since NMFS considers repeated exposure to sound levels that potentially cause TTS to potentially risk causing PTS.

Response: Repeated exposure may cause a marine mammal to exhibit diminished responsiveness (habituation), or disturbance effects may persist; the latter is most likely with sounds that are highly variable in characteristics, infrequent, and unpredictable in occurrence, and associated with situations that a marine mammal perceives as a threat, which will not be the case with Statoil's seismic survey. Additionally, the relatively short crosstrack distance of the 180- and 190-dB radius associated with Statoil's seismic survey result in small areas of overlap of exposed waters during the survey.

Moreover, as explained in detail elsewhere in this document, marine mammals will need to be closer to the seismic source and be exposed to SPLs greater than 190 dB to be exposed to sound levels that could cause TTS. In order for a marine mammal to receive multiple exposures (and thereby incur PTS), the animal would: (1) Need to be close to the vessel and not detected during the period of multiple exposures; (2) be swimming in approximately the same direction and speed as the vessel; and (3) not be deflected away from the vessel as a result of the noise from the seismic array. Preliminary model simulations for seismic surveys in the Gulf of Mexico indicate that marine mammals are unlikely to incur single or multiple exposure levels that could result in PTS, as the seismic vessel would be moving at about 4–5 knots, while the marine mammals would not likely be moving within the zone of potential auditory injury in the same direction and speed as the vessel, especially for those marine mammals that take measures to avoid areas of seismic noise.

Comment 35: NSB indicates that Statoil's approach to estimating densities of beluga and bowhead whales is problematic. The best available scientific data show that most marine mammals move considerable distances over the course of the open water period and are not confined to a small area. This movement occurs throughout the open water period and is most intense during the autumn (late August through November) when marine mammals are migrating south through the Chukchi Sea. NSB requests that NMFS use the most appropriate methods for estimating takes.

AWL also questions the use of a "density" measure in determining take in the Chukchi Sea during the bowhead migration. AWL states that NMFS has recognized in the past that using density is inappropriate for determining bowhead take from seismic activities in the Beaufort Sea during the fall. AWL and NSB point out that Statoil used a density approach which assumes animals remain relatively stationary from one day to the next, but this assumption is inapplicable for surveying that will take place within a migratory corridor. AWL points out that the proposed IHA does not indicate the rationale for using an approach that ignores the fact that bowhead whales will pass through the Chukchi Sea in the fall. Dr. Bain notes that properly taking the bowhead migration into account, along with an appropriate sound threshold for harassment, could dramatically increase the estimate of harassed whales.

Response: Statoil's density estimates for bowhead and beluga whales are based on the best scientific information available, which is the standard required by the MMPA implementing regulations at 50 CFR 216.102(a). The alternative method referred to by AWL for estimating take of migrating bowhead whales was only used for seismic operations in the Beaufort Sea for Shell's site clearance and seismic surveys (75 FR 22708; May 18, 2010). This method has not been applied to activities in the Chukchi Sea. Because the migration corridor is narrower and better defined in the Beaufort Sea than the Chukchi Sea, this method was deemed appropriate by NMFS for seismic operations in the Beaufort. However, the migratory path taken by bowhead whales once they enter the Chukchi Sea is not as well understood. Moreover, the migratory route is not as narrowly defined in the Chukchi. Additionally, if these species avoid areas of active seismic operations at levels lower than 160 dB re 1 μPa (rms), as noted by several of the commenters, then fewer animals will occur in the area of Statoil's operations. After careful evaluation of the methods used by Statoil to estimate take, NMFS has determined that Statoil used the best

scientific information available in calculating the take estimates.

Comment 36: Citing George and Suydam (1998), NSB states that killer whales and ribbon seals occur regularly in the Chukchi Sea and are thus not extralimital, as Statoil described in its IHA application. NSB points out that NMFS should consider ribbon seals, killer whales, and minke whales to occur regularly in the survey area, to be conservative.

Response: NMFS based its population assessment on the Alaska Marine Mammal Stock Assessment Reports (Allen and Angliss 2010), peer-reviewed or other technical articles, and prior year monitoring reports of seismic surveys to estimate the likelihood of their occurrence and calculate the take numbers for the species. Although George and Suydam (1998) reported in their paper on killer whale predation in the northeastern Chukchi and western Beaufort Seas, they acknowledged that "[k]iller whales (*Orcinus orca*) are infrequently reported from the northeastern Chukchi and western Beaufort Seas." Based on the available information, NMFS does not expect that these species are likely to be taken in numbers representing more than a chance occurrence, as specified in the **Federal Register** notice for the proposed IHA (75 FR 32379; June 8, 2010).

Comment 37: NSB points out that Statoil's application does not provide information about the movements of the Beaufort Sea stock of beluga whales through the Chukchi Sea, and that these beluga whales do migrate through the Chukchi Sea during the fall, when Statoil may be conducting seismic activities. NSB further points out that the minimum population estimate of 3,700 in NMFS' Alaska Marine Mammal Stock Assessment Reports (Angliss and Allen 2009) may be an underestimate of the actual population.

Response: Statoil does state in the IHA application that "[i]n the fall, beluga whale densities in the Chukchi Sea are expected to be somewhat higher than in the summer because individuals of the eastern Chukchi Sea stock and the Beaufort Sea stock will be migrating south to their wintering grounds in the Bering Sea." The take estimates of marine mammals are based on the densities of animals in particular areas (*e.g.,* Moore *et al.* 2000), and calculated to yield the number of animals that are likely to be "taken" within modeled zones of influence, as described in details in Statoil's IHA application. Therefore, the calculation of marine mammal take estimation is relevant to its population size. However, stock or population size of a marine mammal species is used in determining whether the number of takes affect a "small number" of marine mammals. For a given level of "take," a species with a small population is expected to experience larger impact than a species with a larger population size. Therefore, contrary to what NSB states, using the minimum population estimate (since the best population estimate is unknown) of eastern Chukchi Sea beluga to calculate the percentage of take is actually a conservative measure to assess takes of marine mammals.

Subsistence Issues

Comment 38: AEWC states that the nondiscretionary congressional directive that there will be no more than a negligible impact to marine mammals and no unmitigable adverse impact on the availability of marine mammals for subsistence taking is consistent with the MMPA's overall treatment of both marine mammal and subsistence protections. AEWC further states that Congress has set a "moratorium on the taking * * * of marine mammals," 16 U.S.C. 1371(a), with the sole exemption provided for the central role of subsistence hunting by Alaska Natives. Thus, AEWC concludes that Congress has given priority to subsistence takes of marine mammals over all other exceptions to the moratorium, which may be applied for and obtained only if certain statutory and regulatory requirements are met. However, AEWC states that incidental harassment authorizations are available only for specified activities for which the Secretary makes the mandated findings. Thus, the pursuit of those activities is subordinated, by law, to the critical subsistence uses that sustain Alaska's coastal communities. AWL and NSB further states that NMFS has not adequately demonstrated that the proposed activities will not have "an unmitigable adverse impact on the availability of such species or stock for taking for subsistence uses."

Response: The MMPA does not prohibit an activity from having an adverse impact on the availability of marine mammals for subsistence uses; rather, the MMPA requires NMFS to ensure the activity does not have an unmitigable adverse impact on the availability of such species or stocks for taking for subsistence uses. NMFS has defined "unmitigable adverse impact" in 50 CFR 216.103 as an impact resulting from the specified activity: (1) That is likely to reduce the availability of the species to a level insufficient for a harvest to meet subsistence needs by: (i) Causing the marine mammals to abandon or avoid hunting areas; (ii) directly displacing subsistence users; or (iii) placing physical barriers between the marine mammals and the subsistence hunters; and (2) that cannot be sufficiently mitigated by other measures to increase the availability of marine mammals to allow subsistence needs to be met.

For the determination of the unmitigable adverse impact analysis, NMFS, other government agencies, and affected stakeholder agencies and communities were provided a copy of the POC in May 2010, which outlined measures Statoil would implement to ensure no unmitigable adverse impact to subsistence uses. The POC specifies times and areas to avoid in order to minimize possible conflicts with traditional subsistence hunts by North Slope villages for transit and open-water activities. Statoil waited to begin activities until the close of the spring beluga hunt in the village of Point Lay. Statoil has also developed a Communication Plan and will implement the plan before initiating the 2010 program to coordinate activities with local subsistence users as well as Village Whaling Associations in order to minimize the risk of interfering with subsistence hunting activities, and keep current as to the timing and status of the bowhead whale migration, as well as the timing and status of other subsistence hunts. The Communication Plan includes procedures for coordination with Communication and Call Centers to be located in coastal villages along the Chukchi Sea during Statoil's program in 2010.

Based on the measures contained in the IHA (and described later in this document), NMFS has determined that mitigation measures are in place to ensure that Statoil's operations do not have an unmitigable adverse impact on the availability of marine mammal species or stocks for subsistence uses.

Comment 39: AWL points out that the importance of bowhead and beluga whales to coastal communities and their acknowledged sensitivity to noise impacts strongly favor a precautionary approach, and that to implement such an approach, NMFS should first undertake a comprehensive assessment of traditional ecological knowledge.

Response: NMFS recognizes the importance of bowhead whales and other marine mammals to coastal communities and thus is taking a precautionary approach in evaluating the potential impacts that may rise from Statoil's seismic surveys. NMFS has prepared an Environmental Assessment (EA) and Finding of No Significant Impact for the issuance of IHAs to Statoil and Shell to take marine

mammals incidental to the proposed seismic and marine surveys in the 2010 open water season in the Beaufort and Chukchi Seas (NMFS 2010). The EA provides a comprehensive review of the traditional ecological knowledge and assessed the potential impacts to the subsistence life in the Arctic from the proposed survey activities.

Mitigation and Monitoring Concerns

Comment 40: NSB and Dr. Bain are concerned that MMOs cannot see animals at the surface when it is dark or during the day because of fog, glare, rough seas, the small size of animals such as seals, and the large portion of time that animals spend submerged. NSB also notes that Statoil has acknowledged that reported sightings are only "minimum" estimates of the number of animals potentially affected by surveying.

Response: NMFS recognizes the limitations of visual monitoring in darkness and other inclement weather conditions. Therefore, in the IHA to Statoil, NMFS requires that no seismic airgun can be ramped up when the entire safety zones are not visible. However, Statoil's operations will occur in an area where periods of darkness do not begin until early September. Beginning in early September, there will be approximately 1–3 hours of darkness each day, with periods of darkness increasing by about 30 min each day. By the end of the survey period, there will be approximately 8 hours of darkness each day. These conditions provide MMOs favorable monitoring conditions for most of the time.

Comment 41: NSB and AEWC note that Statoil asserts that mitigation measures are designed to protect animals from injurious takes, but it is not clear that these mitigation measures are effective in protecting marine mammals or subsistence hunters. AEWC states that data previously presented by Shell and ConocoPhillips from their seismic activities made clear that MMOs failed to detect many marine mammals that encroached within the designated safety zones. AEWC also states that laser rangefinding binoculars are not useful in measuring distances to animals directly.

Response: NMFS believes that the required monitoring and mitigation measures are effective and are an adequate means of effecting the least practicable impact to marine mammals and their habitats. The monitoring reports from 2006, 2007, 2008, and 2009 do not note any instances of serious injury or mortality (Patterson *et al.* 2007; Funk *et al.* 2008; Ireland *et al.* 2009; Reiser *et al.* 2010). Additionally, the fact that a power-down or shutdown is required does not indicate that marine mammals are not being detected or that they are incurring serious injury. As discussed elsewhere in this document and in the Notice of Proposed IHA (75 FR 32379; June 8, 2010), the received level of a single seismic pulse (with no frequency weighting) might need to be approximately 186 dB re 1 μPa^2-s (*i.e.,* 186 dB sound exposure level [SEL]) in order to produce brief, mild TTS (a non-injurious, Level B harassment) in odontocetes. Exposure to several strong seismic pulses that each have received levels near 175–180 dB SEL might result in slight TTS in a small odontocete, assuming the TTS threshold is (to a first approximation) a function of the total received pulse energy. For Statoil's proposed survey activities, the distance at which the received energy level (per pulse) would be expected to be ≥175–180 dB SEL is the distance to the 190 dB re 1 µPa (rms) isopleth (given that the rms level is approximately 10–15 dB higher than the SEL value for the same pulse). Seismic pulses with received energy levels ≥175–180 dB SEL (190 dB re 1 µPa (rms)) are modeled to be restricted to a radius of approximately 700 m around the airgun array, but are likely to be smaller due to the larger airgun array used in modeling.

For baleen whales, there are no data, direct or indirect, on levels or properties of sound that are required to induce TTS. The frequencies to which baleen whales are most sensitive are lower than those to which odontocetes are most sensitive, and natural background noise levels at those low frequencies tend to be higher. As a result, auditory thresholds of baleen whales within their frequency band of best hearing are believed to be higher (less sensitive) than are those of odontocetes at their best frequencies (Clark and Ellison 2004). From this, it is suspected that received levels causing TTS onset may also be higher in baleen whales.

In pinnipeds, TTS thresholds associated with exposure to brief pulses (single or multiple) of underwater sound have not been measured. Initial evidence from prolonged exposures suggested that some pinnipeds may incur TTS at somewhat lower received levels than do small odontocetes exposed for similar durations (Kastak *et al.* 1999; 2005). However, more recent indications are that TTS onset in the most sensitive pinniped species studied (harbor seal, which is closely related to the ringed seal) may occur at a similar SEL as in odontocetes (Kastak *et al.* 2004).

NMFS concluded that cetaceans and pinnipeds should not be exposed to pulsed underwater noise at received levels exceeding, respectively, 180 and 190 dB re 1 µPa (rms). The established 180- and 190-dB re 1 µPa (rms) criteria are not considered to be the levels above which TTS might occur. Rather, they are the received levels above which, in the view of a panel of bioacoustics specialists convened by NMFS before TTS measurements for marine mammals started to become available, one could not be certain that there would be no injurious effects, auditory or otherwise, to marine mammals. As summarized above, data that are now available imply that TTS is unlikely to occur unless bow-riding odontocetes are exposed to airgun pulses much stronger than 180 dB re 1 µPa rms (Southall *et al.* 2007). No cases of TTS are expected as a result of Statoil's proposed activities given the small size of the source, the strong likelihood that baleen whales (especially migrating bowheads) would avoid the approaching airguns (or vessel) before being exposed to levels high enough for there to be any possibility of TTS, and the mitigation measures proposed to be implemented during the survey described later in this document.

There is no empirical evidence that exposure to pulses of airgun sound can cause PTS in any marine mammal, even with large arrays of airguns (*see* Southall *et al.* 2007). PTS might occur at a received sound level at least several decibels above that inducing mild TTS if the animal is exposed to the strong sound pulses with very rapid rise time. Given the higher level of sound necessary to cause PTS, it is even less likely that PTS could occur. In fact, even the sound levels immediately adjacent to the airgun may not be sufficient to induce PTS, especially because a mammal would not be exposed to more than one strong pulse unless it swam immediately alongside the airgun for a period longer than the inter-pulse interval. Baleen whales, and belugas as well, generally avoid the immediate area around operating seismic vessels. The planned monitoring and mitigation measures, including visual monitoring, power-downs, and shutdowns of the airguns when mammals are seen within the safety radii, will minimize the already-minimal probability of exposure of marine mammals to sounds strong enough to induce PTS.

NMFS does not believe that MMOs failed to detect many marine mammals that encroached within the designated safety zones. As indicated in the monitoring reports for prior years' open water seismic surveys, marine mammals were routinely detected before and

during seismic surveys using airgun arrays. Although the reports reveal that a few marine mammals entered the designated safety zone without being detected immediately, these events occurred very infrequently and shutdowns were called for immediately when a marine mammal was found within the safety zone. Despite these rare occurrences, NMFS does not believe animals would have experienced TTS or injury because, as noted throughout this document, the 180 dB and 190 dB thresholds for injury are conservative and the best available science indicates animals need to be exposed to significantly higher received levels or for much longer duration to experience TTS, let alone injury, which was very unlikely in the cases documented in prior years' surveys.

NMFS acknowledges that night-time monitoring by using night vision devices is not nearly as effective as visual observation during daylight hours. Therefore, the IHA issued to Statoil prohibits start up of seismic airguns when the entire safety zone cannot be effectively monitored during the night-time hours. Therefore, if Statoil has a shutdown of its seismic airgun array during low-light hours, it will have to wait till daylight to start ramping up the airguns.

Comment 42: Citing the report from the peer review panel created for the 2010 Open Water meeting, AWL points out that the report stated that Statoil's "proposed methods would not be sufficient for adequate monitoring of the area within the safety radii when the radii are far from the vessel." NSB also questions the ability of MMOs to detect marine mammals within the 2,500 m safety radii of 180-dB isopleths. AWL further points out that the proposed IHA needs to clarify how marine mammal observers on the support vessels will assist in monitoring safety zones, because the peer review comments noted that even with the addition of two support vessels, Statoil "will be able to monitor only a limited area."

Response: First, the comment by the peer review panel in March 2010 during the Open Water meeting in Anchorage, Alaska, was based on a draft version of the Statoil's IHA application, which did not include monitoring measures such as the use of "Big Eye" binoculars (25 x 50). In working with Statoil, NMFS has required the applicant to include the use of "Big Eye" binoculars as a standard device for marine mammal monitoring. In addition, NMFS has also included a number of recommendations from the peer review panel as requirements in the IHA to improve marine mammal monitoring during Statoil's seismic survey. These recommendations, which are discussed in more detail below, include: (1) The use of "big eyes" paired with searching with the naked eye; (2) use of the best possible positions for observing (e.g., outside and as high on the vessel as possible); and (3) pairing experienced MMOs with MMOs who are lacking experience. Further, the estimated safety radii for 180-dB and 190-dB isopleths are at 2,500 m and 700 m from the seismic airgun source, respectively, based on modeling of a large airgun array (3,147 in^3) and adjusted upward. The empirically measured distances from this bigger airgun array from 2006–2009 were 460 m, 550 m, and 610 m for the 190-dB isopleths, and 1,400 m, 2,470 m, and 2,000 m for the 180-dB isopleths. All these safety radii are smaller than the estimated ones for the smaller airgun array. Therefore, NMFS expects that the empirically measured safety radii for the airgun array used in Statoil's proposed seismic survey would be much smaller than currently modeled, which would reduce the distance to be monitored.

Regarding the use of support vessels to assist in monitoring safety zones and zones of influence, the lead MMO on the seismic source vessel (or his/her designee) will work with the seismic contractor and/or the Captain to identify areas that will be ensonified to levels ≥160 dB during the next 24- to 48-hour time period. Based on this information MMOs on the source vessel will communicate that information to MMOs and the Captains of support vessels. Statoil will have two support vessels (*Tanux I* and *Norseman I*) assisting the seismic source vessel with this monitoring and other project-related activities. Monitoring routes within the ≥160 dB are often a series of zig-zags, or a racetrack pattern. The goal is to maximize monitoring coverage within the ≥160 dB zone as dictated by support vessel availability, daylight, and survey conditions to ensure that aggregates of non-migratory baleen whales are not present within the zone. Support vessels will transit to and begin monitoring of these locations while maintaining routine communications with the source vessel MMOs to report monitoring status and any relevant sightings.

Comment 43: AWL and Dr. Bain note that NMFS appears to simply presume that marine mammals will naturally avoid airguns when they are operating (even when limited to the single mitigation gun), removing the need for monitoring when conditions prevent observers from effectively watching for intrusions into the exclusion zones. AWL and NSB point out that the requirement for ramp ups rests on the same foundation—that marine mammals will leave an affected area as a result of increasing noise. Citing a report by the Joint Subcommittee on Ocean Science and Technology (JSOST 2009), AWL questions the efficacy of ramp up. NSB also questions the ability of power down and shutdown to protect marine mammals.

Response: NMFS recognizes that uncertainties regarding marine mammal responses to seismic airgun noise still exist, including avoidance, behavioral reactions, temporary displacement, etc. However, there are many field studies and observations indicating that animals are not likely to occur within an area where sound levels could cause impairment to their auditory apparatus (*see* review by Richardson *et al.* 1995; Southall *et al.* 2007). In addition, monitoring reports during prior years' seismic surveys all record more marine mammal sightings in the vicinity of the seismic vessel when airguns are off than when airguns are on (Patterson *et al.* 2007; Funk *et al.* 2008; Ireland *et al.* 2009; Reiser *et al.* 2010).

For the time period of Statoil's seismic surveys, daylight will occur for 24 h/day until mid-August. Until that date MMOs will automatically be observing during the 30-minute period preceding a ramp up. Later in the season when visibility becomes low, MMOs will be called out at night to observe prior to and during any ramp up using night vision devices (Generation 3 binocular image intensifiers, or equivalent units). Nevertheless, in the IHA NMFS requires that no airgun can be started for ramp up if the entire safety zones cannot be visually observed for at least 30 minutes.

NMFS recognizes that the efficacy of ramp-up has not been well studied. However, before additional scientific information becomes available to show its lack of effectiveness in warning away marine mammals, the employment of ramp up will be required. To help evaluate the utility of ramp-up procedures, NMFS will require observers to record and report their observations during any ramp-up period. An analysis of these observations may lead to new information regarding the effectiveness of ramp-up and should be included in the monitoring report for the 2010 Statoil seismic survey.

Nevertheless, NMFS is confident about the efficacy of power down and especially shutdown in protecting marine mammals from Level A and B harassment from seismic noise sources. By shutting down the airgun array, there will be no seismic noise produced, therefore, marine mammals are unlikely

be taken by Level A and B harassment from noise exposure. Similarly, by powering down the acoustic source, the safety zones will be reduced, and marine mammals that were in these zones will now be placed outside the zones ensonified by a smaller airgun source.

Comment 44: The Commission recommends NMFS require the applicant to collect data on the behavior and movements of any marine mammals present during all ramp-up and power-down procedures to help evaluate the effectiveness of these procedures as mitigation measures; and (2) undertake or prompt others to undertake studies needed to resolve questions regarding the effectiveness of ramp-up and power-down as mitigation measures. NSB also questions the effectiveness of ramp-up measures.

Response: In order to issue an incidental take authorization (ITA) under Sections 101(a)(5)(A) and (D) of the MMPA, NMFS must, where applicable, set forth the permissible methods of taking pursuant to such activity, and other means of effecting the least practicable impact on such species or stock and its habitat, paying particular attention to rookeries, mating grounds, and areas of similar significance, and on the availability of such species or stock for taking for certain subsistence uses (where relevant). For Statoil's proposed open water seismic surveys, a series of mitigation and monitoring measures are required under the IHA. These mitigation measures include: (1) Sound source measurements to determine safety zones more accurately, (2) establishment of safety and disturbance zones to be monitored by MMOs on the seismic vessel, (3) a power-down when a marine mammal is detected approaching a safety zone and a shutdown when a marine mammal is observed within a zone, (4) ramp-up of the airgun array, and (5) a requirement that vessels reduce speed when within 274 m (300 yards) of whales and steer around those whales if possible.

The basic rationale for these mitigation measures is (a) to avoid exposing marine mammals to intense seismic airgun noises at received levels that could cause TTS (for mitigation measures listed as (1) through (4)); and (b) to avoid vessel strike of marine mammals (mitigation measure (5)). Although limited research in recent years shows that noise levels that could induce TTS in odontocetes and pinnipeds are much higher than current NMFS safety thresholds (i.e., 180 dB and 190 dB re 1 μPa (rms) for cetaceans and pinnipeds, respectively), mitigation measures listed in (1) through (3) provide very conservative measures to ensure that no marine mammals are exposed to noise levels that would result in TTS. The power-down measure listed in (3) requires Statoil to reduce the firing airguns accordingly so that a marine mammal that is detected approaching the safety zone will be further away from the reduced safety radius (as a result of power-down).

Regarding mitigation measures requiring ramp-ups and power-down, while scientific research built around the question on whether ramp-up is effective has not been conducted, several studies on the effects of anthropogenic noise on marine mammals indicate that many marine mammals will move away from a sound source that they find annoying (*e.g.* Malme *et al.* 1984; Miller *et al.* 1999; others reviewed in Richardson *et al.* 1995). In particular, three species of baleen whales have been the subject of tests involving exposure to sounds from a single airgun, which is equivalent to the first stage of ramp-up. All three species were shown to move away at the onset of a single airgun operation (Malme *et al.* 1983; 1984; 1985; 1986; Richardson *et al.* 1986; McCauley *et al.* 1998; 2000). From this research, it can be presumed that if a marine mammal finds a noise source annoying or disturbing, it will move away from the source prior to sustaining an injury, unless some other over-riding biological activity keeps the animal from vacating the area. This is the premise supporting NMFS' and others' belief that ramp-up is effective in preventing injury to marine mammals. However, to what degree ramp-up protects marine mammals from exposure to intense noises is unknown. For power-down, the rationale is that by powering down airgun arrays, marine mammals that are exposed to received noise levels that could induce TTS will be exposed to lower levels of sound due to the reduction in the output of the airgun source. Nevertheless, NMFS will require industry applicants that will conduct marine or seismic surveys in the 2010 open water season to collect, record, analyze, and report MMO observations during any ramp-up and power-down periods.

Comment 45: Citing Thomas *et al.* (2002), Dr. Bain states that the effective strip half-width (μ, the point at which the number of animals sighted beyond that distance equals the number missed inside) is the maximum distance at which the species of interest can be sighted (w), then the number of animals missed closer to the vessel than μ equals the number of animals sighted between μ and w. Dr. Bain further assumes that μ is the distance to the 180 dB contour (isopleths, the approximate value of μ in Figure 15.3 of Richardson and Thomas (2002) for Beaufort 0–3) and w is the distance to the 160 dB contour (isopleths), and points out that if one whale is seen in the outer zone (radius of 13 km for the 160-dB isopleths) "where the sighting probability is say 9% or less," that would suggest that one whale was missed in the inner zone (radius of 2.5 km for the 180-dB isopleths), and 10 were missed in the outer zone. Dr. Bain concludes that "the sighting of a single whale outside the strip half-width would be strong evidence that 12 are present." Dr. Bain thus summarizes that "if a whale is sighted in the inner zone, the airguns would shut down per the 180 dB rule. If a whale is sighted in the outer zone, that would imply that 12 are present within the 160 dB contour, and hence the airguns should shut down per the 160 dB rule. That is, sighting a single bowhead or gray whale, regardless of distance, is evidence the shutdown criteria have been met." Dr. Bain further states that even if no whales are seen, the shutdown criteria may have been meet, as he states that from high observation platforms (11–27 m in eye height), a pair of observers has about a 60% chance of detecting a mysticete whale at the 180-dB isopleths (2.5 km), and that for the paired observation team plots, where sample size is larger, the observers are estimated to have about a 50% chance of seeing a whale at 2.5 km. That is, Dr. Bain concludes, "a whale can be in the zone where there is a risk of immediate injury or death and have only a 50% chance of triggering a shutdown under ideal conditions." Dr. Bain then applies the same logic for seals and states that "a high proportion of seals within the 190 dB contour will fail to trigger a shutdown."

Response: While NMFS agrees with Dr. Bain's assessment in principle, NMFS disagrees with a number of assumptions being made in his comments. First, the reference Dr. Bain used to extrapolate the effective strip half-width (μ = 2.5 km) and sighting probability (9%) addresses correction factors that were used for aerial surveys. Although aerial surveys are conducted at higher platforms than vessel surveys, the speed of an aircraft (approximately 100 knots) does not allow adequate time for scanning a particular area, and thus may miss marine mammals if they happen to be underwater. Therefore, using an aerial sighting probability of 9% to address vessel surveys may not be appropriate. Second, Dr. Bain's

hypothetical 9% sighting probability is based on the assumption of using one survey platform only. For Statoil's proposed seismic survey, multiple vessels besides the source vessel will be employed for marine mammal monitoring, and these chase/monitoring vessels are able to fill the sighting gaps that MMOs from the source vessel may miss. Third, using sighting probability for the entire survey tracklines may not be a realistic way to predict the number of animals in the vicinity of the survey area, which tends to be moving constantly. Unless the animals congregate in a large group, sighting probability at an instantaneous location should be interpreted as the percentage of probability of detecting a single animal, instead of the percentage of a group of animals in the area. Therefore, it does not seem reasonable to call for a shutdown of seismic airguns when a whale is detected in the 160-dB zone of influence.

Regarding Dr. Bain's second comment that a whale has a 50% chance of facing the risk of immediate injury or death when occurring at a distance of 2.5 km is scientifically baseless. First, even if the whale or seals were not spotted by the MMOs at 2.5 km or 700 m, respectively, from the seismic vessel, the modeled received levels at these distances are expected to be approximately 180 dB and 190 re 1 μPa (rms), respectively, which are the borderline of the safety zone within which repeated exposure to noise received levels above 180 dB or 190 dB re 1 μPa (rms) could induce TTS. TTS is not considered an injury in cetaceans or pinnipeds. As discussed in detail in the proposed IHA (75 FR 32379; June 8, 2010) and in this document below, new scientific information shows that the onset of TTS is likely at much higher received levels. Second, as the whales are closing in, the sighting probability increases exponentially with reduced distance, reaching to over 80% at a distance of 600 m based on Figure 5.3 of Richardson and Thomas (2002). At this distance, the received levels are expected to be under 200 dB re 1 μPa (rms), which is still lower than the levels that are thought to induce TTS (Finneran *et al.* 2002; Southall *et al.* 2007). Third, as the seismic survey is ongoing, NMFS considers it's unlikely that a marine mammal would be approaching a noise received level that could be uncomfortable to the animal or cause TTS. Therefore, Dr. Bain's conclusion that a whale will face 50% chance of immediate injury or death at 2,500 m away from the seismic survey vessel is scientifically not supported.

Comment 46: Dr. Bain states that since animals over the horizon would be affected, visual detection from the seismic vessel alone would be inadequate to prevent exposure. It would be advisable to deploy trained observers on all vessels, not only the one operating airguns, which would allow sighting of some marine mammals that are close enough to be affected by noise, but too far away to be seen from source-based observers.

Response: As stated in Statoil's IHA application, five observers will be based aboard the seismic source vessel and at least three MMOs on the chase/monitoring vessels. The IHA issued to Statoil requires that MMOs be stationed onboard both source vessels and chase/monitoring vessels (see Monitoring Measures section below).

Comment 47: Dr. Bain states that short ramp-up periods do not allow individuals to move out to the contour at which behavioral effects no longer pose risks of immediate injury prior to onset of full power operation. He concludes that many marine mammals would at least need to reach the 135 dB contour to be safe from behaviorally mediated injury, and that for the airgun array used in this survey, that is likely to be over 40 km away. Dr. Bain further concludes that at normal sustained swimming speeds of 3–4 knots, that is likely to be at least 5–6 hours away.

Response: First, claiming that marine mammals exposed to received levels at 135 dB are not safe from immediate injury is not scientifically supported, and many studies have shown that on many occasions animals being exposed to this level of noise have not exhibited any behavioral reactions, much less a reaction that would equate to "take" under the MMPA (see reviews by Richardson *et al.* 1995; Southall *et al.* 2007).

Second, it is important to understand that no airgun will be ramped up when a marine mammal is detected within the safety zones (180 dB for cetaceans and 190 dB for pinnipeds) by MMOs on source vessel and chase/monitoring vessels, as stated in the IHA. This means, theoretically, Statoil's seismic vessel cannot even start up the 60 in ^{3} mitigation airgun when cetaceans or pinnipeds are detected within the 2,500 m or 700 m radii, respectively. As the operators start ramping up with the mitigation gun, as stated in the **Federal Register** notice for the proposed IHA (75 FR 32379; June 8, 2010) and in the Statoil's IHA application, the initial safety zones incurred by the mitigation gun are 220 m and 75 m for 180 dB and 190 dB, respectively.

Third, even if there are marine mammals being missed during the initial 30 minutes pre-survey monitoring, the ramping up of the mitigation gun to full-power airgun array would make the safety radii from 220 m to 2,500 m for the 180-dB isopleths and from 75 m to 700 m for the 190-dB isopleths reachable within approximately 15–20 minutes. Using simple math, if a marine mammal is swimming at normal sustained speed of 4 knots (7.41 km/h), the animal would reach the border of the 180-dB isopleths in 20 minutes (it would take pinnipeds 11 minutes to reach the 190-dB isopleths from the dead center of the airgun source, assuming a swimming speed of 3 knots (5.56 km/h)).

Finally, anytime during the ramp up period when a marine mammal is detected within its respective safety zone, the airguns must be immediately stopped, and ramp up will be delayed until the animal is sighted outside of the safety zone or the animal is not sighted for at least 15–30 minutes (15 minutes for small odontocetes and pinnipeds, or 30 minutes for baleen whales and large odontocetes).

Comment 48: The Commission, NSB, and Dr. Bain recommend that Statoil be required to supplement its mitigation measures by using passive acoustic monitoring (PAM) to provide a more reliable estimate of the number of marine mammals taken during the course of the proposed seismic survey.

Response: NMFS' 2010 EA for this action contains an analysis of why PAM is not required to be used by Statoil to implement mitigation measures. Statoil, Shell, and ConocoPhillips (CPAI) are jointly funding an extensive science program to continue the acoustic monitoring of the Chukchi Sea environment. However, this information will not be used in a real-time or near-real-time capacity. Along with the fact that marine mammals may not always vocalize while near the PAM device, another impediment is that flow noise generated by a towed PAM will interfere with low frequency whale calls and make their detection difficult and unreliable. MMS sponsored a workshop on the means of acoustic detection of marine mammals in November 2009 in Boston, MA. The workshop reviewed various available acoustic monitoring technology (passive and active), its feasibility and applicability for use in MMS-authorized activities, and what additional developments need to take place to improve its effectiveness. The conclusion is that at this stage, using towed passive acoustics to detect marine mammals is not a mature technology. NMFS may consider

requirements for PAM in the future depending on information received as the technology develops further.

Comment 49: AWL states that additional mitigation measures are needed to address vulnerable cow/calf pairs. AWL recommends that NMFS require a safety zone that is triggered by the presence of cow/calf pairs because females with calves are considered to be more susceptible to noise disturbances, and NMFS must at least evaluate the necessity of additional mitigation to protect this vulnerable segment of the population, citing MMS' Lease Sale 193 EIS that female baleen whales with calves "show a heightened response to noise and disturbance."

Response: Although it has been suggested that female baleen whales with calves "show a heightened response to noise and disturbance," there is no evidence that such "heightened response" is biologically significant and constitutes a "take" under the MMPA. Nevertheless, NMFS requires a 120–dB safety zone for migrating bowhead cow/calf pairs to be implemented to reduce impacts to the animals as they migrate through the narrow corridor in the Beaufort Sea (*see* **Federal Register** notice for proposed IHA to Shell; 75 FR 22708; May 18, 2010). However, in the Chukchi Sea, the migratory corridor for bowhead whales is wider and more open, thus the 120–dB ensonified zone would not impede bowhead whale migration. The animals would be able to swim around the ensonified area. Additionally, NMFS has not imposed a requirement to conduct aerial monitoring of the 120–dB safety zone for the occurrence of four or more cow-calf pairs in the Chukchi Sea because it is not practicable. First, NMFS determined that monitoring the 120–dB safety zone was not necessary in the Chukchi Sea because there would not be the level of effort by 3D seismic survey operations present in 2006. This provides cow/calf pairs with sufficient ability to move around the seismic source without significant effort. Second, aerial surveys are not required in the Chukchi Sea because they have currently been determined to be impracticable due to lack of adequate landing facilities, and the prevalence of fog and other inclement weather in that area. This could potentially result in an inability to return to the airport of origin, thereby resulting in safety concerns.

Comment 50: AWL states that NMFS should consider time and space limitations on surveying in order to reduce harm, and to restrict surveys to times in which the safety zones are visible to marine monitors. AWL requests that Statoil not operate in conditions—such as darkness, fog, or rough seas—in which the observers are unable to ensure that the safety zones are free of marine mammals. In addition, AWL requests NMFS to evaluate the benefits that would come from halting the surveying during the peak of the bowhead migration through the Chukchi Sea.

Response: In making its negligible determination for the issuance of an IHA to Statoil for open water marine surveys, NMFS has conducted a thorough review and analysis on how to reduce any adverse effects to marine mammals from the proposed action, including the consideration of time and space limitations that could reduce impacts to the bowhead migration. As indicated in its IHA application, Statoil will complete its seismic survey in the first half of October to avoid the peak of the bowhead whale migration through the Chukchi Sea, which typically occurs after October. By restricting survey activities to only daylight hours, Statoil will not be able to complete its seismic surveys before its preferred date, and therefore, there could be more adverse impacts to migrating bowhead whales.

Bowhead whales migrating west across the Alaskan Beaufort Sea in autumn, in particular are unusually responsive to airgun noises, with avoidance occurring out to distances of 20—30 km from a medium-sized airgun source (Miller *et al.* 1999; Richardson *et al.* 1999). However, while bowheads may avoid an area of 20 km (12.4 mi) around a noise source, when that determination requires a post-survey computer analysis to find that bowheads have made a 1 or 2 degree course change, NMFS believes that does not equate to "take" under the MMPA, and that such minor behavioral modification is not likely to be biologically significant.

Comment 51: NSB requests NMFS to require Statoil to fly aerial surveys in support of its proposed activities.

Response: Aerial monitoring is not required in IHAs for surveys that occur in the offshore environment of the Chukchi Sea because they have currently been determined to be impracticable due to lack of adequate landing facilities, and the prevalence of fog and other inclement weather in that area. This could potentially result in an inability to return to the airport of origin, thereby resulting in safety concerns.

Comment 52: The Commission recommends that NMFS (1) revise its study design to include expanded pre- and post-seismic survey assessments sufficient to obtain reliable sighting data for comparing marine mammal abundance, distribution, and behavior under various conditions; (2) review the proposed monitoring measures and require the applicant (or its contractors) to collect and analyze information regarding all of the potentially important sources of sound and the complex sound field created by all of the activities associated with conducting the seismic survey; (3) require the applicant to collect information to evaluate the assumption that 160 dB is the appropriate threshold at which harassment occurs for all marine mammals that occur in the survey area; and (4) determine, in consultation with Statoil, whether aerial surveys are safe to conduct and should be required and, if not, identify alternative monitoring strategies capable of providing reliable information on the presence of marine mammals and the impact of survey activities to the affected species and stocks.

Response: NMFS largely agrees with the Commission's recommendations and has been working with the seismic survey applicants and their contractors on gathering information on acoustic sources, survey design review, and monitoring analyses. NMFS has contacted Statoil and received information on all the active acoustic sources that would be used for its proposed open water marine surveys. The information includes source characteristics such as frequency ranges and source levels, as well as estimated propagation loss.

However, due to the strict time limits for the entire seismic program (60 days of seismic surveys), NMFS does not consider it appropriate to revise its study design to include expanded pre- and post-seismic survey assessments to obtain sighting data for comparing marine mammal abundance, distribution, and behavior under various conditions. Such studies would require scientists with expertise in marine mammal distribution, population ecology, and behavioral ecology onboard the research vessel for extended period of time. NMFS thinks that such a requirement is outside the scope of the proposed action. Nevertheless, marine mammal sighting data and behavioral reactions prior to and immediately after seismic operations will be collected, as described in the proposed IHA (75 FR 32379; June 8, 2010) and in Statoil's IHA application. This information will be used to interpret marine mammal behavioral reactions when exposed to various received noise levels (except levels about 180 dB and 190 dB re 1 μPa for cetaceans and pinnipeds,

respectively) and abundance in relation to seismic surveys, which can be used to evaluate whether 160 dB received level is the appropriate threshold at which harassment occurs for all marine mammals that occur in the survey area.

As far as aerial surveys are concerned, they are not required in the Chukchi Sea because they have currently been determined to be impracticable due to lack of adequate landing facilities, and the prevalence of fog and other inclement weather in that area. This could potentially result in an inability to return to the airport of origin, thereby resulting in safety concerns. However, Statoil is required to use two support vessels to monitor marine mammals in the zones of influence. Nevertheless, NMFS will continue working with the oil and gas industry in discussing the possibility of aerial surveys in the future.

Comment 53: The Commission recommends that the IHA require Statoil to halt its seismic survey and consult with NMFS regarding any seriously injured or dead marine mammal when the injury or death may have resulted from Statoil's activities. NSB recommends Statoil be required to facilitate the recovery and necropsy of any marine mammals found dead in their survey area.

Response: NMFS concurs with the Commission's recommendation. NMFS has included a condition in the IHA which requires Statoil to immediately shutdown the seismic airguns if a dead or injured marine mammal has been sighted within an area where the seismic airguns were operating within the past 24 hours so that information regarding the animal can be collected and reported to NMFS, and there is clear evidence that the injury or death resulted from Statoil's activities. In addition, Statoil must immediately report the events to the Marine Mammal Stranding Network within 24 hours of the sighting (*telephone:* 1–800–853–1964), as well as to the NMFS staff person designated by the Director, Office of Protected Resources, or to the staff person designated by the Alaska Regional Administrator. The lead MMO is required to complete a written certification, which must include the following information: species or description of the animal(s); the condition of the animal(s) (including carcass condition if the animal is dead); location and time of first discovery; observed behaviors (if alive); and photographs or video (if available). In the event that the marine mammal injury or death was determined to have been a direct result of Statoil's activities, then operations will cease, NMFS and the Stranding Network will be notified immediately, and operations will not be permitted to resume until NMFS has had an opportunity to review the written certification and any accompanying documentation, make determinations as to whether modifications to the activities are appropriate and necessary, and has notified Statoil that activities may be resumed.

For any other sighting of injured or dead marine mammals in the vicinity of any marine survey activities utilizing underwater active acoustic sources for which the cause of injury or mortality cannot be immediately determined, Statoil will ensure that NMFS (regional stranding coordinator) is notified immediately. Statoil will provide NMFS with species or description of the animal(s), the condition of the animal(s) (including carcass condition if the animal is dead), location, time of first discovery, observed behaviors (if alive), and photo or video.

If NMFS determines that further investigation is appropriate, once investigations are completed and determinations made, NMFS would use available information to help reduce the likelihood that a similar event would happen in the future and move forward with necessary steps to ensure environmental compliance for oil and gas related activities under the MMPA.

Since the cause of marine mammal deaths often cannot be determined immediately, and in many cases the deaths are results of gunshots or other trauma unrelated to Statoil's seismic surveys, NMFS does not believe it reasonable and practicable to require Statoil to facilitate the recovery and necropsy of any marine mammals found dead in their survey area.

Cumulative Impact Concerns

Comment 54: NSB, AEWC, and AWL state that NMFS must also consider the effects of disturbances in the context of other activities occurring in the Arctic. NSB states that NMFS should ascertain the significance of multiple exposures to underwater noise, ocean discharge, air pollution, and vessel traffic—all of which could impact bowhead whales and decrease survival rates or reproductive success. NSB notes that the cumulative impacts of all industrial activities must be factored into any negligible impact determination. NSB, AEWC, and AWL list a series of reasonably foreseeable activities in the Arctic Ocean as: (1) GX Technology's Beaufort Sea seismic surveys; (2) Shell's Beaufort and Chukchi Seas marine surveys; (3) Seismic surveys planned in the Canadian Arctic; (4) U.S. Geological Survey's (USGS') seismic surveys; (5) BP's production operations at Northstar; and (6) Dalmorneftegeophysica (DMNG) Russian Far East offshore seismic surveys.

Response: Under section 101(a)(5)(D) of the MMPA, NMFS is required to determine whether the taking by the applicant's specified activity will take only small numbers of marine mammals, will have a negligible impact on the affected marine mammal species or population stocks, and will not have an unmitigable impact on the availability of affected species or stocks for subsistence uses. Cumulative impact assessments are NMFS' responsibility under the National Environmental Policy Act (NEPA), not the MMPA. In that regard, MMS' 2006 Final PEA, NMFS' 2007 and 2008 Supplemental EAs, NMFS' 2009 EA, and NMFS' 2010 EA address cumulative impacts. The most recent NMFS' 2010 EA addresses cumulative activities and the cumulative impact analysis focused on oil and gas related and non-oil and gas related activities in both Federal and State of Alaska waters that were likely and foreseeable. The oil and gas related activities in the U.S. Arctic in 2010 include this activity; Shell's proposed marine surveys in the Beaufort and Chukchi Seas; ION Geophysical's proposed seismic survey in Beaufort Sea; and BP's production operations at Northstar. GX Technology's Beaufort Sea seismic surveys have been cancelled by the company. Seismic survey activities in the Canadian and Russian Arctic occur in different geophysical areas, therefore, they are not analyzed under the NMFS 2010 EA. Other appropriate factors, such as Arctic warming, military activities, and noise contributions from community and commercial activities were also considered in NMFS' 2010 EA. Please refer to that document for further discussion of cumulative impacts.

Comment 55: Dr. Bain notes that in Southall *et al.* (2007), a severity scale was developed to allow a graded description of behavioral changes rather than forcing a binary decision about whether a particular change constitutes a take. Dr. Bain states that changes low on the scale would only have population-scale effects if the changes were long lasting due to long-term exposure, or were widespread due to sources affecting a large percentage of populations. That is, the population consequences of a single vessel passing by a dolphin would be expected to be less than a fleet of vessels spending many hours per day for months every year dolphin watching, even if behavioral responses were the same to

each vessel approach (Lusseau *et al.* 2006). Changes high on the scale could result in immediate injury or death through mechanisms such as stranding, gas bubble formation, separation of mothers from calves, stampedes, etc., if they occurred in the relevant setting (Southall *et al.* 2007)

Response: Comment noted. As Dr. Bain has noted, long-term exposure to low level noise could have chronic, population level impacts to marine mammals in their environment greater than similar exposures that are short-term and infrequent, even though the instantaneous behavioral reactions are scored the same. NMFS agrees with the example that whales and dolphins being approached by whale watching vessels operating on a daily basis for many hours over a period of years are likely to suffer far more population consequences than, for example, marine mammals exposed to infrequent and short term sounds from seismic and supporting vessels that only operate in an area for two months. In addition to the received noise levels being considered, seismic vessels are required to implement mitigation and monitoring conditions to ensure a certain distance from marine mammals, while whale watching vessels usually do not. This is an important difference, as vessels associated with Statoil's seismic survey will not actually approach marine mammals. As analyzed in detail in the **Federal Register** notice (75 FR 32379; June 8, 2010) and in this document, the proposed Statoil seismic survey in the Chukchi Sea would only affect a limited area over approximately 60 days.

ESA Concerns

Comment 56: AWL states that NMFS section 7 consultation under the ESA must consider the potential impact of potential future oil and gas activities. AWL further states that a biological opinion must detail how the agency action under review affects the species or its critical habitat. The effects of the action are then added to the "environmental baseline," which consists of the past and present impacts of activities in the action area as well as "the anticipated impacts of all proposed Federal projects of activities in the action area" as well as "the anticipated impacts of all proposed Federal projects in the action area that have already undergone formal or early section 7 consultation." AWL states that NMFS must consider the effects of the entire agency action.

Response: Under section 7 of the ESA, NMFS Office of Protected Resources has completed consultation with NMFS Alaska Regional Office on "Authorization of Small Takes under the Marine Mammal Protection Act for Certain Oil and Gas Exploration Activities in the U.S. Beaufort and Chukchi Seas, Alaska for 2010." In a Biological Opinion issued on July 13, 2010, NMFS concluded that the issuance of the incidental take authorizations under the MMPA for seismic surveys are not likely to jeopardize the continued existence of the endangered humpback or bowhead whale. As no critical habitat has been designated for these species, none will be affected. The 2010 Biological Opinion takes into consideration all oil and gas related seismic survey activities that would occur in the 2010 open water season. This Biological Opinion does not include impacts from exploratory drilling and production activities, which are subject to a separate consultation. In addition, potential future impacts from oil and gas activities will be subject to consultation in the future when activities are proposed. NMFS has reviewed Statoil's proposed action and has determined that the findings in the 2010 Biological Opinion apply to its 2010 Chukchi Sea seismic survey. In addition, NMFS has issued an Incidental Take Statement (ITS) under this Biological Opinion for Statoil's survey activities, which contains reasonable and prudent measures with implementing terms and conditions to minimize the effects of take of bowhead and humpback whales.

Comment 57: AWL argues that NMFS' existing regional biological opinion is inadequate. AWL states that NMFS' 2008 Biological Opinion does not adequately consider site-specific information related to Shell's proposed drilling. AWL points out that Shell has proposed exploration drilling in Camden Bay in the Beaufort Sea, and that Camden Bay has been repeatedly identified as a resting and feeding area for migrating bowheads, which has been reaffirmed by the recent monitoring. AWL states that NMFS should re-examine the potential impacts of Shell's proposed drilling in light of its long-standing policy and the cautionary language contained in its 2008 opinion.

Response: NMFS initiated a section 7 consultation under the ESA for the potential impacts to ESA-listed marine mammal species that could be adversely affected as a result of several oil and gas related activities in the 2010 open-water season. The 2010 Biological Opinion covered the activities by Shell and Statoil's proposed open water marine and seismic survey activities. However, as far as Shell's drilling activities are concerned, Shell has withdrawn these actions due to the moratorium on offshore drilling.

Comment 58: Dr. Bain states that bowheads are endangered, and many threats unrelated to oil have limited recovery of other bowhead population, so need to be considered.

Response: In issuing the IHA to Statoil for the proposed marine seismic survey, NMFS has thoroughly considered all potential impacts to marine mammals, including bowhead, gray, and beluga whales and harbor porpoises in the project vicinity. A detailed discussion of the cumulative effects on these species and the Arctic environment as a whole is provided in NMFS 2010 EA for the issuance of IHAs to Shell and Statoil.

Specific to the ESA-listed bowhead whales, as well as humpback and fin whales, NMFS Office of Protected Resources has conducted a consultation with NMFS Alaska Regional Office (AKRO) under section 7 of the ESA. After reviewing the current status of the fin, humpback, and bowhead whale, the environmental baseline for the action area, the biological and physical impacts of these actions, and cumulative effects, and considering that the described actions are expected to impact only a single stock of each of these endangered whales, and not the species as a whole, NMFS AKRO issued a Biological Opinion on July 13, 2010. The Biological Opinion concludes that the proposed marine and seismic surveys by Shell and Statoil in the Beaufort and Chukchi Seas during the 2010 open water season are not likely to jeopardize the continued existence of the endangered fin, humpback, or bowhead whale. No critical habitat has been designated for these species, therefore none will be affected. In addition, the population of the Bering-Chukchi-Beaufort Sea stock of bowhead whales is increasing at a rate of 3.5% (Brandon and Wade 2004) or 3.4% (George *et al.* 2004), despite whales being harvested by the Alaska natives (Angliss and Allen 2009). The count of 121 calves during the 2001 census was the highest yet recorded and was likely caused by a combination of variable recruitment and the large population size (George *et al.* 2004). The calf count provides corroborating evidence for a healthy and increasing population (Angliss and Allen 2009).

Comment 59: AWL argues that NMFS' 2008 Biological Opinion does not adequately consider oil spills. AWL states that in the 2008 Biological Opinion, NMFS recognized the potential dangers of a large oil spill, and that whales contacting oil, particularly freshly-spilled oil, "could be harmed

and possibly killed." Citing NMFS's finding in its 2008 Biological Opinion that several "coincidental events" would have to take place for such harm to occur: (1) A spill; (2) that coincides with the whales' seasonal presence; (3) that is "transported to the area the whales occupy (*e.g.,* the migrational corridor or spring lead system)"; and (4) is not successfully cleaned up, AWL points out that this combination of events is not as remote as NMFS appears to have assumed because NMFS' analysis of whether a spill may occur relies in part on statistical probabilities based on past incidents. AWL states that there appears to have been a significant breakdown in the system that was intended to both prevent spills from occurring and require adequate oil spill response capabilities to limit the harm. AWL states that NMFS must take into account that there are likely gaps in the current regulatory regime, and that given those flaws, an analysis that relies on the safety record of previous drilling is doubtful as a predictive tool.

Response: As discussed in the previous Response to Comment, no drilling is planned for Shell during the 2010 open water season, therefore, these activities will be considered in a separate consultation if and when Statoil proposes to conduct exploratory drilling.

NEPA Concerns

Comment 60: AEWC believes that NMFS excluded the public from the NEPA process since NMFS did not release a draft EA for the public to review and provide comments prior to NMFS taking its final action.

Response: Neither NEPA nor the Council on Environmental Quality's (CEQ) regulations explicitly require circulation of a draft EA for public comment prior to finalizing the EA. The Federal courts have upheld this conclusion, and in one recent case, the Ninth Circuit squarely addressed the question of public involvement in the development of an EA. In *Bering Strait Citizens for Responsible Resource Development* v. *U.S. Army Corps of Engineers* (524 F.3d 938, 9th Cir. 2008), the court held that the circulation of a draft EA is not required in every case; rather, Federal agencies should strive to involve the public in the decision-making process by providing as much environmental information as is practicable prior to completion of the EA so that the public has a sufficient opportunity to weigh in on issues pertinent to the agency's decision-making process. In the case of Statoil's 2010 MMPA IHA request, NMFS involved the public in the decision-making process by distributing Statoil's IHA application and addenda for a 30-day notice and comment period. However, at that time, a draft EA was not available to provide to the public for comment. The IHA application and NMFS' Notice of Proposed IHA (75 FR 32379; June 8, 2010) contained information relating to the project. For example, the application included a project description, its location, environmental matters such as species and habitat to be affected, and measures designed to minimize adverse impacts to the environment and the availability of affected species or stocks for subsistence uses.

Comment 61: AEWC notes that Statoil's IHA application warrants review in an environmental impact statement (EIS) given the potential for significant impacts.

Response: NMFS' 2010 EA was prepared to evaluate whether significant environmental impacts may result from the issuance of an IHA to Statoil, which is an appropriate application of NEPA. After completing the EA, NMFS determined that there would not be significant impacts to the human environment and accordingly issued a FONSI. Therefore, an EIS is not needed for this action.

Comment 62: AEWC, AWL, and NSB note that NMFS is preparing a Programmatic EIS (PEIS). Although MMS published a draft PEIS (PEIS; MMS 2007) in the summer of 2007, to date, a Final PEIS has not been completed. AWL also notes that NMFS and MMS have reaffirmed their previous determination that a programmatic EIS process is necessary to address the overall, cumulative impacts of increased oil and gas activity in the Arctic Ocean and intend to incorporate into that analysis new scientific information as well as new information about projected seismic and exploratory drilling activity in both seas. However, AWL and AEWC argue that NEPA regulations make clear that NMFS should not proceed with authorizations for individual projects like Statoil's surveying until its programmatic EIS is complete.

Response: While the Final PEIS will analyze the affected environment and environmental consequences from seismic surveys in the Arctic, the analysis contained in the Final PEIS will apply more broadly to Arctic oil and gas operations. NMFS' issuance of an IHA to Staoil for the taking of several species of marine mammals incidental to conducting its open-water seismic survey program in the Chukchi Sea in 2010, as analyzed in the EA, is not expected to significantly affect the quality of the human environment. Statoil's surveys are not expected to significantly affect the quality of the human environment because of the limited duration and scope of Statoil's operations. Additionally, the EA contained a full analysis of cumulative impacts.

Miscellaneous Issues

Comment 63: The AEWC states that Statoil has refused to sign the 2010 Open Water Season Conflict Avoidance Agreement (CAA), despite very significant concessions by the AEWC. AEWC believes the greatest concern here is the fact that NMFS must find, on behalf of the Secretary, that Statoil's proposed operations will not have an unmitigable adverse impact on the availability of marine mammals for subsistence uses. AEWC claims that in the absence of a CAA, NMFS has no independent basis on which to make this finding.

Response: Under sections 101(a)(5)(A) and (D) of the MMPA (16 U.S.C. 1361 *et seq.*), an IHA or LOA shall be granted to U.S. citizens who engage in a specified activity (other than commercial fishing) within a specified geographical region if NMFS finds that the taking of marine mammals will have a negligible impact on the species or stock(s) and will not have an unmitigable adverse impact on the availability of the species or stock(s) for certain subsistence uses, and if the permissible methods of taking and requirements pertaining to the mitigation, monitoring and reporting of such takings are set forth. In other words, no marine mammal take authorizations may be issued if NMFS has reason to believe that the proposed exploration or development activities would have an unmitigable adverse impact on the availability of marine mammal species or stock(s) for Alaskan native subsistence uses. For the proposed marine surveys, Statoil has conducted Plan of Cooperation (POC) meetings for its seismic operations in the Chukchi Sea in the communities and villages of Barrow, Wainwright, Point Lay, and Point Hope, and met with representatives of the Marine Mammal Co-Management groups, including the AEWC, Ice Seal Commission, Alaska Beluga Whale Committee, Alaska Eskimo Walrus Commission, and the Nanuq Commission, on March 22, 2010. At each of these meetings, Statoil described the proposed survey program and measures it plans to take, or has taken, to minimize adverse effects its proposed seismic survey may have on the

availability of marine mammals for subsistence use. Statoil requested comments and feedback from subsistence users, and incorporated those comments and concerns in the final version of the POC, which was released on May 28, 2010. The final POC document contains the following information: (1) A description of the proposed marine seismic survey; (2) documentation of consultation with local communities and tribal governments; (3) a description of mitigation measures to reduce the impact of Statoil's planned activity on subsistence; (4) ongoing Chukchi Sea scientific research which Statoil is conducting to gather information on the marine environment; and (5) the future plans for meetings and communication with the affected subsistence Chukchi Sea communities.

In addition, Statoil has entered into a Communication Protocol through a Participation Agreement with Shell to fund and staff a communications station out of Wainwright. The communications center will be staffed by Inupiat operators and on a 24/7 basis during the 2010 subsistence bowhead whale hunt. Call center staff will receive notifications from vessels at least once every six hours and will plot the probable location of vessels on a map at the communications center. Communications center staff will apprise vessel operators of potential operations that may conflict with subsistence whaling activities.

The measures that Statoil has taken, and will take, under the POC, Marine Mammal Monitoring and Mitigation Plan (4MP), and the Participation Agreement are similar to the measures identified in the draft Conflict Avoidance Agreement provided by AEWC. Below, Statoil and NMFS identify the key conflict-avoidance provisions of the CAA, and identify the corresponding provisions of the POC, 4MP, and the Participation Agreement focused on minimizing impacts to the environment and subsistence resources in the Chukchi Sea.

(1) Post-Seasons Review/Preseason Introduction

Under section 108 of the CAA, following the completion of the 2010 Chukchi Sea Open Water Season, and prior to the start of the 2011 season, the AEWC or Whaling Captain's Association of each village may request meetings with Industry Participants to review the results of the 2010 operations and discuss village concerns. Immediately following the above meetings, the CAA provides that Industry Participants will provide a brief introduction of their planned activities for the 2011 Season.

Section 3 of the POC contains a commitment to community engagement and cooperation activities that is in keeping with the spirit of the CAA, including meetings before and after the Open Water Season. In particular, the POC provides that consultation, "both formally and informally, will continue before, during, and after the 2010 seismic survey activities. Feedback from the marine mammal co-management group representatives and subsistence users is valued by Statoil and will be useful for our planned seismic survey and potential future activities."

(2) Marine Mammal Observers and Communications

Under Title II of the CAA, Industry Participants agree to employ MMOs/Inupiat Communicators (IC) on board each Primary Sound Source Vessel that they own or operate. The CAA provides detail about the general duties of the MMO/IC, including the duty to keep a lookout for bowhead whales and marine mammals in the vessels' vicinity, provide direct contact with subsistence whaling boats in the area to avoid conflict, and remain subject to the regular code of employee conduct on board the vessels. Title II of the CAA also covers responsibilities by Industry Participant vessels and subsistence hunting vessels to report in to appropriate Communications System Coordination Centers (Com-Centers) at regular intervals, communicate between vessels, and use communication capabilities to further avoid conflict to aid Industry Participants to avoid areas of active whale hunts. The sections also cover the general operation scheme and protocol for Com-Centers, duties of Com-Center operators, and types of communications equipment to use.

The POC, in section 4.2, contains detailed language about the use of MMOs and Inupiaq MMOs with Traditional Knowledge.

Under the POC, at least five observers will be based aboard the seismic source vessel and at least three MMOs on the chase/monitoring vessels when there are 24 hours of daylight, decreasing as the hours of daylight decrease. Primary roles for MMOs are defined as monitoring for the presence of marine mammals during all daylight airgun operations and during any nighttime ramp-up of the airguns. The MP provides additional detail on the number of MMOs, crew rotations, and observer qualification and training requirements, as well as monitoring methodology, including protocols for poor visibility and night monitoring, use of specialized field equipment, field data-recording, verification, handling, and security, and field reporting. Lastly, the Participation Agreement provides that Statoil (and Shell) will fund a 24/7 communications center staffed by Inupiat personnel. The center will have contact with all vessels at least once every hour.

(3) Vessel Operations

Title III of the CAA covers vessel operations, including the duty of vessel operators to report to appropriate Com-Centers and notify them of operation plan changes. The section also provides measures for avoiding potential interaction with bowhead whales, as well as appropriate sound signature data for each vessel.

Section 4.3 of the POC contains a discussion of mitigation measures that includes: using the best known technology and seismic equipment to minimize impacts; airgun array power down, shut down, and ramp-up procedures to be implemented; cost-sharing participation for Com-Centers; the implementation of Awareness and Interaction Plans to lower the impact of seismic surveys on polar bear and walrus; monitoring ice conditions and movement; and supporting a search and rescue helicopter base as a part of the project plan. The MP contains significant detail on Statoil's agreement to mitigate impacts by adopting stringent safety and disturbance zones, and power down, shut down, and ramp-up protocols. The Participation Agreement discusses logistical support and shore services, including Statoil's pledge to share in the cost burden of maintaining the Wainwright ComCenter and protocols for operations of the Com-Center.

(4) Vessels, Testing, and Monitoring

Title IV of the CAA covers equipment standards and requirements protocols for the sound signature tests, monitoring plans, the use of existing information, procedures for handling raw data gathered during tests, and cumulative noise impact studies.

In the POC, section 2.2 provides detailed descriptions of the vessels to be used during the seismic survey. Section 4.1 provides additional detail regarding vessel and seismic equipment protocols to reduce impacts. Specifically, the POC pledges that Statoil will use the "best known technology and seismic equipment to minimize impacts to the environment," including: equipping vessels with the latest technology and waste management systems; using 12 streamers in the seismic receiver array to reduce the number of times the vessel

must traverse and the amount of shot points needed to cover the entire survey area; using solid streamers which do not contain contaminants that could leak.

(5) Avoiding Conflicts

Title V of the CAA specifically centers on conflict avoidance, and contains guidelines for routing vessels and aircraft and limiting vessel speeds for the avoidance of bowhead whales and subsistence hunts, limitations for geophysical activity, and specific provisions for drilling and production.

Section 3 of the POC, as discussed above, contains a significant commitment to cooperation activities and community engagement. In addition to the continuation of formal and informal consultation, the POC also contains measures outlining Statoil's commitment to continued engagement with marine mammal co-management groups and other community cooperation engagements far outside the scope of the CAA. For example, Statoil has participated in a JIP on Oil Spills in Ice, where Norwegian authorities allowed oil spills in broken ice, with the ultimate goal of developing more effective prevention and mitigation measures.

In summary, the POC, 4MP, and Participation Agreement contain provisions that either directly match or match the spirit of those provisions of the CAA focused on avoiding conflicts between the industry and subsistence users; ensuring short and long-term cooperation and consultation with subsistence users; and commitments to ongoing scientific research of topics such as species distribution, seabed studies, and acoustic monitoring programs.

NMFS has scrutinized all of the documents submitted by Statoil (*e.g.,* IHA application, 4MP, Plan of Cooperation and other correspondence to NMFS and affected stakeholders) and documents submitted by other affected stakeholders and concluded that harassment of marine mammals incidental to Statoil's activities will not have more than a negligible impact on marine mammal stocks or an unmitigable adverse impact on the availability of marine mammals for taking for subsistence uses. This finding was based in large part on NMFS' definition of "negligible impact," "unmitigable adverse impact," the proposed mitigation and monitoring measures, the scope of activities proposed to be conducted, including time of year, location and presence of marine mammals in the project area, and Statoil's Plan of Cooperation.

Besides bowhead whale hunting, beluga whales are hunted for subsistence at Barrow, Wainwright, Point Lay, and Point Hope, with the most taken by Point Lay (Fuller and George 1997). Harvest at all of these villages generally occurs between April and July with most taken in April and May when pack-ice conditions deteriorate and leads open-up. Ringed, bearded, and spotted seals are hunted by all of the villages bordering the project area (Fuller and George 1997). Ringed and bearded seals are hunted throughout the year, but most are taken in May, June, and July when ice breaks up and there is open water instead of the more difficult hunting of seals at holes and lairs. Spotted seals are only hunted in spring through summer.

In addition, the proposed seismic surveys by Statoil would only occur for a brief period of 60 days. It would also occur far offshore, approximately 70 miles, outside the area in which harvest traditionally occurs. NMFS does not expect subsistence users to be directly displaced by the seismic surveys because subsistence users typically do not travel this far offshore to harvest marine mammals. Moreover, because of the significant distance offshore and the lack of hunting in these areas, there is no expectation that any physical barriers would exist between marine mammals and subsistence users.

Finally, the required mitigation and monitoring measures are expected to reduce any adverse impacts on marine mammals for taking for subsistence uses to the extent practicable. These measures include, but are not limited to, the 180 dB and 190 dB safety (shut-down/power-down) zones; a requirement to monitor the 160 dB isopleths for aggregations of 12 or more non-migratory balaenidae whales and when necessary shut-down seismic airguns; reducing vessel speed to 10 knots or less when a vessel is within 300 yards of whales to avoid a collision; utilizing communication centers to avoid any conflict with subsistence hunting activities; and the use of marine mammal observers.

Over the past several months, NMFS has worked with both Alaska Native communities and the industry, to the extent feasible, to resolve any Alaska Native concerns from the proposed open water marine and seismic surveys. These efforts include convening an open water stakeholders' meeting in Anchorage, AK, in March 2010, and multiple conference meetings with representatives of the Alaska Native communities and the industry.

Comment 64: AEWC notes that, in 2009, NMFS did not publish its response to comments on proposed IHAs activities conducted during the open water season until well after the fall subsistence hunt at Cross Island had concluded and geophysical operations had already taken place. AEWC states that NMFS' failure to release its response to comments until after the activities had taken place casts serious doubt on the validity of NMFS' public involvement process and the underlying analysis of impacts to subsistence activities and marine mammals.

Response: NMFS does not agree with AEWC's statement that NMFS' failure to release its response to comments until after the activities had taken place casts doubt on the validity of NMFS' public involvement process, or the underlying analysis of impacts to subsistence activities and marine mammals. As stated earlier, the decision to issue an IHA to Statoil for its proposed seismic surveys in the Chukchi Sea is based in large part on NMFS' definition of "negligible impact," "unmitigable adverse impact," the proposed mitigation and monitoring measures, the scope of activities proposed to be conducted, including time of year, location and presence of marine mammals in the project area, extensive research and studies on potential impacts of anthropogenic sounds to marine mammals, marine mammal behavior, distribution, and movements in the vicinity of Statoil's proposed project areas, Statoil's Plan of Cooperation, and on public comments received during the commenting period and peer-review recommendations by an independent review panel. The reason that NMFS was not able to publish its response to comments on proposed IHA activities in 2009 for Shell's shallow hazards and site clearance surveys until the end of the survey activities was due to the large amount of comments NMFS received. NMFS was able to review and analyze all comments it received and address their validity for the issuance of the IHA. However, due to the large volume of comments, NMFS was not able to organize them into publishable format to be incorporated into the **Federal Register** notice for publication on a timely basis. NMFS will strive to make sure that in the future all comments are addressed in full and published by the time IHAs are issued, as NMFS has done for the 2010 open-water seismic IHAs.

Description of Marine Mammals in the Area of the Specified Activity

Eight cetacean and four pinniped species under NMFS jurisdiction could occur in the general area of Statoil's open water marine seismic survey area

in the Chukchi Sea. The species most likely to occur in the project vicinity include two cetacean species: Beluga (*Delphinapterus leucas*) and bowhead whales (*Balaena mysticetus*), and three seal species: Ringed (*Phoca hispida*), spotted (*P. largha*), and bearded seals (*Erignathus barbatus*). Most encounters are likely to occur in nearshore shelf habitats or along the ice edge. The marine mammal species that is likely to be encountered most widely (in space and time) throughout the period of the open water seismic survey is the ringed seal. Encounters with bowhead and beluga whales are expected to be limited to particular regions and seasons, as discussed below.

Other marine mammal species that have been observed in the Chukchi Sea but are less frequent or uncommon in the project area include harbor porpoise (*Phocoena phocoena*), narwhal (*Monodon monoceros*), killer whale (*Orcinus orca*), fin whale (*Balaenoptera physalus*), minke whale (*B. acutorostrata*), humpback whale (*Megaptera novaeangliae*), gray whale (*Eschrichtius robustus*), and ribbon seal (*Histriophoca fasciata*). These species could occur in the project area, but each of these species is uncommon or rare in the area and relatively few encounters with these species are expected during the proposed marine seismic survey. The narwhal occurs in Canadian waters and occasionally in the Beaufort Sea, but it is rare there and is not expected to be encountered. There are scattered records of narwhal in Alaskan waters, including reports by subsistence hunters, where the species is considered extralimital (Reeves *et al.* 2002). Point Barrow, Alaska, is the approximate northeastern extent of the harbor porpoise's regular range (Suydam and George 1992). Humpback, fin, and minke whales have recently been sighted in the Chukchi Sea but very rarely in the Beaufort Sea. Greene *et al.* (2007) reported and photographed a humpback whale cow/calf pair east of Barrow near Smith Bay in 2007, which is the first known occurrence of humpbacks in the Beaufort Sea. Savarese *et al.* (2009) reported one minke whale sighting in the Beaufort Sea in 2007 and 2008. Ribbon seals do not normally occur in the Beaufort Sea; however, two ribbon seal sightings were reported during vessel-based activities near Prudhoe Bay in 2008 (Savarese *et al.* 2009).

The bowhead, fin, and humpback whales are listed as "endangered" under the Endangered Species Act (ESA) and as depleted under the MMPA. Certain stocks or populations of gray, beluga, and killer whales and spotted seals are listed as endangered or proposed for listing under the ESA; however, none of those stocks or populations occur in the proposed activity area. Additionally, the ribbon seal is considered a "species of concern" under the ESA, and the bearded and ringed seals are "candidate species" under the ESA, meaning they are currently being considered for listing.

Statoil's application contains information on the status, distribution, seasonal distribution, and abundance of each of the species under NMFS jurisdiction mentioned in this document. Please refer to the application for that information (see **ADDRESSES**). Additional information can also be found in the NMFS Stock Assessment Reports (SAR). The Alaska 2009 SAR is available at: *http://www.nmfs.noaa.gov/pr/pdfs/sars/ak2009.pdf.*

Monitoring Plan Peer Review

The MMPA requires that monitoring plans be independently peer reviewed "where the proposed activity may affect the availability of a species or stock for taking for subsistence uses" (16 U.S.C. 1371(a)(5)(D)(ii)(III)). Regarding this requirement, NMFS' implementing regulations state, "Upon receipt of a complete monitoring plan, and at its discretion, [NMFS] will either submit the plan to members of a peer review panel for review or within 60 days of receipt of the proposed monitoring plan, schedule a workshop to review the plan" (50 CFR 216.108(d)).

NMFS convened an independent peer review panel to review Statoil's Marine Mammal Monitoring and Mitigation Plan (4MP) for the Marine Seismic Surveys of Selected Lease Areas in the Alaskan Chukchi Sea in 2010. The panel met on March 25 and 26, 2010, and provided their final report to NMFS on April 22, 2010. The full panel report can be viewed at: *http://www.nmfs.noaa.gov/pr/permits/incidental.htm#applications.*

NMFS provided the panel with Statoil's 4MP and asked the panel to address the following questions and issues for Statoil's plan:

(1) The monitoring program should document the effects (including acoustic) on marine mammals and document or estimate the actual level of take as a result of the activity. Does the monitoring plan meet this goal?

(2) Ensure that the monitoring activities and methods described in the plan will enable the applicant to meet the requirements listed in (1) above;

(3) Are the applicant's objectives achievable based on the methods described in the plan?

(4) Are the applicant's objectives the most useful for understanding impacts on marine mammals?

(5) Should the applicant consider additional monitoring methods or modifications of proposed monitoring methods for the proposed activity? And

(6) What is the best way for an applicant to report their data and results to NMFS?

Section 3 of the report contains recommendations that the panel members felt were applicable to all of the monitoring plans reviewed this year. Section 4.6 of the report contains recommendations specific to Statoil's Open Water Marine Seismic Survey Program 4MP. Specifically, for the general recommendations, the panel commented on issues related to: (1) Acoustic effects of oil and gas exploration—assessment and mitigation; (2) aerial surveys; (3) MMOs; (4) visual near-field monitoring; (5) visual far-field monitoring; (6) baseline biological and environmental information; (7) comprehensive ecosystem assessments and cumulative impacts; (8) duplication of seismic survey effort; and (9) whale behavior.

NMFS has reviewed the report and evaluated all recommendations made by the panel. NMFS has determined that there are several measures that Statoil can incorporate into its 2010 Open Water Marine Survey Program 4MP to improve it. Additionally, there are other recommendations that NMFS has determined would also result in better data collection, and could potentially be implemented by oil and gas industry applicants, but which likely could not be implemented for the 2010 open water season due to technical issues (see below). While it may not be possible to implement those changes this year, NMFS believes that they are worthwhile and appropriate suggestions that may require a bit more time to implement, and Statoil should consider incorporating them into future monitoring plans should Statoil decide to apply for IHAs in the future.

The following subsections lay out measures that NMFS recommends for implementation as part of the 2010 Open Water Marine Survey Program 4MP and those that are recommended for future programs.

Recommendations for Inclusion in the 2010 4MP and IHA

Section 3.3 of the panel report contains several recommendations regarding MMOs, which NMFS agrees that Statoil should incorporate:

- Observers should be trained using visual aids (e.g., videos, photos), to help them identify the species that they are

likely to encounter in the conditions under which the animals will likely be seen.

• Observers should understand the importance of classifying marine mammals as "unknown" or "unidentified" if they cannot identify the animals to species with confidence. In those cases, they should note any information that might aid in the identification of the marine mammal sighted. For example, for an unidentified mysticete whale, the observers should record whether the animal had a dorsal fin.

• Observers should attempt to maximize the time spent looking at the water and guarding the safety radii. They should avoid the tendency to spend too much time evaluating animal behavior or entering data on forms, both of which detract from their primary purpose of monitoring the safety zone.

• "Big eye" binoculars (25 x 150) should be used from high perches on large, stable platforms. They are most useful for monitoring impact zones that extend beyond the effective line of sight. With two or three observers on watch, the use of "big eyes" should be paired with searching by naked eye, the latter allowing visual coverage of nearby areas to detect marine mammals. When a single observer is on duty, the observer should follow a regular schedule of shifting between searching by naked-eye, low-power binoculars, and "big-eye" binoculars based on the activity, the environmental conditions, and the marine mammals of concern.

• Observers should use the best possible positions for observing (e.g., outside and as high on the vessel as possible), taking into account weather and other working conditions.

• Whenever possible, new observers should be paired with experienced observers to avoid situations where lack of experience impairs the quality of observations. If there are Alaska Native MMOs, the MMO training that is conducted prior to the start of the survey activities should be conducted with both Alaska Native MMOs and biologist MMOs being trained at the same time in the same room. There should not be separate training courses for the different MMOs.

In Section 3.4, panelists recommend collecting some additional data to help verify the utility of the "ramp-up" requirement commonly contained in IHAs. To help evaluate the utility of ramp-up procedures, NMFS will require observers to record and report their observations during any ramp-up period. An analysis of these observations may lead to additional information regarding the effectiveness of ramp-up and should be included in the monitoring report.

Among other things, Section 3.5 of the panel report recommends recording visibility data because of the concern that the line-of-sight distance for observing marine mammals is reduced under certain conditions. MMOs should "carefully document visibility during observation periods so that total estimates of take can be corrected accordingly".

Section 4.6 of the report contains recommendations specific to Statoil's Open Water Marine Seismic Survey Program 4MP. Of the recommendations presented in this section, NMFS has determined that the following should be implemented for the 2010 season:

• Summarize observation effort and conditions, the number of animals seen by species, the location and time of each sighting, position relative to the survey vessel, the company's activity at the time, each animal's response, and any adjustments made to operating procedures. Provide all spatial data on charts (always including vessel location).

• Make all data available in the report or (preferably) electronically for integration with data from other companies.

• Accommodate specific requests for raw data, including tracks of all vessels and aircraft associated with the operation and activity logs documenting when and what types of sounds are introduced into the environment by the operation.

NMFS spoke with Statoil about the inclusion of these recommendations into the 2010 4MP and IHA. Statoil indicated to NMFS that they will incorporate these recommendations into the 4MP, and NMFS has made several of these recommendations requirements in the IHA.

Recommendations for Inclusion in Future Monitoring Plans

Section 3.5 of the report recommends methods for conducting comprehensive monitoring of a large-scale seismic operation. One method for conducting this monitoring recommended by panel members is the use of passive acoustic devices. Additionally, Section 3.2 of the report encourages the use of such systems if aerial surveys will not be used for real-time mitigation monitoring. NMFS acknowledges that there are challenges involved in using this technology to detect bowhead whale vocalizations in conjunction with seismic airguns in this environment, especially in real time. However, NMFS recommends that Statoil work to help develop and improve this type of technology for use in the Arctic (and use it once it is available and effective), as it could be valuable both for real-time mitigation implementation, as well as archival data collection. Statoil indicated to NMFS that they have been working for several years to aid in the development of such technology and will continue to do so.

The panelists also recommend adding a tagging component to monitoring plans. "Tagging of animals expected to be in the area where the survey is planned also may provide valuable information on the location of potentially affected animals and their behavioral responses to industrial activities. Although the panel recognized that such comprehensive monitoring might be difficult and expensive, such an effort (or set of efforts) reflects the complex nature of the challenge of conducting reliable, comprehensive monitoring for seismic or other relatively-intense industrial operations that ensonify large areas of ocean." While this particular recommendation is not feasible for implementation in 2010, NMFS recommends that Statoil consider adding a tagging component to future seismic survey monitoring plans should Statoil decide to conduct such activities in future years.

To the extent possible, NMFS recommends implementing the recommendation contained in Section 4.6.6 for the 2010 season: "Integrate all observer data with information from tagging and acoustic studies to provide a more comprehensive description of the acoustic environment during its survey." However, NMFS recognizes that this integration process may take time to implement. Therefore, Statoil should begin considering methods for the integration of the observer data now if Statoil intends to apply for IHAs in the future.

In Section 3.4, panelists recommend collecting data to evaluate the efficacy of using forward-looking infrared devices (FLIR) vs. night-vision binoculars. The panelists note that while both of these devices may increase detection capabilities by MMOs of marine mammals, the reliability of these technologies should be tested under appropriate conditions and their efficacy evaluated. NMFS recommends that Statoil design a study to explore using both FLIR and night-vision binoculars and collect data on levels of detection of marine mammals using each type of device.

Other Recommendations in the Report

The panel also made several recommendations, which are not

discussed in the two preceding subsections. NMFS determined that many of the recommendations were made beyond the bounds of what the panel members were tasked to do. For example, the panel recommended that NMFS begin a transition away from using a single metric of acoustic exposure to estimate the potential effects of anthropogenic sound on marine living resources. This is not a recommendation about monitoring but rather addresses a NMFS policy issue. NMFS is currently in the process of revising its acoustic guidelines on a national scale. A recommendation was also made regarding the training and oversight of MMOs. NMFS is currently working on a national policy for this as well. Section 3.7 of the report contains several recommendations regarding comprehensive ecosystem assessments and cumulative impacts. These are good, broad recommendations; however, the implementation of these recommendations would not be the responsibility solely of oil and gas industry applicants. The recommendations require the cooperation and input of several groups, including Federal, state, and local government agencies, members of other industries, and members of the scientific research community. NMFS will encourage the industry and others to build the relationships and infrastructure necessary to pursue these goals, and incorporate these recommendations into future MMPA authorizations, as appropriate. Lastly, Section 3.8 of the report makes a recommendation regarding data sharing and reducing the duplication of seismic survey effort. While this is a valid recommendation, it does not relate to monitoring or address any of the six questions which the panel members were tasked to answer.

For some of the recommendations, NMFS felt that additional clarification was required by the panel members before NMFS could determine whether or not applicants should incorporate them into the monitoring plans. Section 3.2 of the report discusses the use of and methods for conducting aerial surveys. Industry applicants have not conducted aerial surveys in Chukchi Sea lease sale areas for several years because of the increased risk for flying there (as noted by the panel report). To that end, NMFS has asked the panel to provide recommendations on whether or not similar surveys could be conducted from dedicated vessel-based platforms. NMFS also asked for additional clarification on some of the recommendations regarding data collection and take estimate calculations. In addition, NMFS asked the panel members for clarification on the recommendation contained in Section 3.6 regarding baseline studies. Lastly, NMFS asked the panel members for clarification on the recommendation specific to Statoil contained in Section 4.6 regarding estimating statistical power for all methods intended to detect adverse impacts. Once NMFS hears back from the panel and is clear with these recommendations, NMFS will follow up with Statoil and discuss the implementation of these additional measures in future years.

Potential Effects of the Specified Activity on Marine Mammals

Operating a variety of active acoustic sources such as airguns and echo sounders can impact marine mammals in a variety of ways.

Potential Effects of Airgun and Sonar Sounds on Marine Mammals

The effects of sounds from airgun pulses might include one or more of the following: Tolerance, masking of natural sounds, behavioral disturbance, and temporary or permanent hearing impairment or non-auditory effects (Richardson *et al.* 1995). As outlined in previous NMFS documents, the effects of noise on marine mammals are highly variable, and can be categorized as follows (based on Richardson *et al.* 1995):

(1) Tolerance

Numerous studies have shown that pulsed sounds from airguns are often readily detectable in the water at distances of many kilometers. Numerous studies have also shown that marine mammals at distances more than a few kilometers from operating seismic vessels often show no apparent response. That is often true even in cases when the pulsed sounds must be readily audible to the animals based on measured received levels and the hearing sensitivity of that mammal group. Although various baleen whales, toothed whales, and (less frequently) pinnipeds have been shown to react behaviorally to airgun pulses under some conditions, at other times, mammals of all three types have shown no overt reactions. In general, pinnipeds and small odontocetes seem to be more tolerant of exposure to airgun pulses than baleen whales.

(2) Behavioral Disturbance

Marine mammals may behaviorally react to sound when exposed to anthropogenic noise. These behavioral reactions are often shown as: Changing durations of surfacing and dives, number of blows per surfacing, or moving direction and/or speed; reduced/increased vocal activities; changing/cessation of certain behavioral activities (such as socializing or feeding); visible startle response or aggressive behavior (such as tail/fluke slapping or jaw clapping); avoidance of areas where noise sources are located; and/or flight responses (*e.g.,* pinnipeds flushing into water from haulouts or rookeries).

The biological significance of many of these behavioral disturbances is difficult to predict, especially if the detected disturbances appear minor. However, the consequences of behavioral modification could be expected to be biologically significant if the change affects growth, survival, and reproduction. Some of these significant behavioral modifications include:

- Drastic change in diving/surfacing patterns (such as those thought to be causing beaked whale stranding due to exposure to military mid-frequency tactical sonar);
- Habitat abandonment due to loss of desirable acoustic environment; and
- Cease feeding or social interaction.

For example, at the Guerreo Negro Lagoon in Baja California, Mexico, which is one of the important breeding grounds for Pacific gray whales, shipping and dredging associated with a salt works may have induced gray whales to abandon the area through most of the 1960s (Bryant *et al.* 1984). After these activities stopped, the lagoon was reoccupied, first by single whales and later by cow-calf pairs.

The onset of behavioral disturbance from anthropogenic noise depends on both external factors (characteristics of noise sources and their paths) and the receiving animals (hearing, motivation, experience, demography) and is also difficult to predict (Southall *et al.* 2007).

Currently NMFS uses 160 dB re 1 µPa at received level for impulse noises (such as airgun pulses) as the onset of marine mammal behavioral harassment.

Mysticete: Baleen whales generally tend to avoid operating airguns, but avoidance radii are quite variable. Whales are often reported to show no overt reactions to airgun pulses at distances beyond a few kilometers, even though the airgun pulses remain well above ambient noise levels out to much longer distances (reviewed in Richardson *et al.* 1995; Gordon *et al.* 2004). However, studies done since the late 1990s of migrating humpback and migrating bowhead whales show reactions, including avoidance, that sometimes extend to greater distances than documented earlier. Therefore, it

appears that behavioral disturbance can vary greatly depending on context, and not just on received levels alone. Avoidance distances often exceed the distances at which boat-based observers can see whales, so observations from the source vessel can be biased. Observations over broader areas may be needed to determine the range of potential effects of some large-source seismic surveys where effects on cetaceans may extend to considerable distances (Richardson *et al.* 1999; Moore and Angliss 2006). Longer-range observations, when required, can sometimes be obtained via systematic aerial surveys or aircraft-based observations of behavior (*e.g.,* Richardson *et al.* 1986, 1999; Miller *et al.* 1999, 2005; Yazvenko *et al.* 2007a, 2007b) or by use of observers on one or more support vessels operating in coordination with the seismic vessel (*e.g.,* Smultea *et al.* 2004; Johnson *et al.* 2007). However, the presence of other vessels near the source vessel can, at least at times, reduce sightability of cetaceans from the source vessel (Beland *et al.* 2009), thus complicating interpretation of sighting data.

Some baleen whales show considerable tolerance of seismic pulses. However, when the pulses are strong enough, avoidance or other behavioral changes become evident. Because the responses become less obvious with diminishing received sound level, it has been difficult to determine the maximum distance (or minimum received sound level) at which reactions to seismic pulses become evident and, hence, how many whales are affected.

Studies of gray, bowhead, and humpback whales have determined that received levels of pulses in the 160–170 dB re 1 μPa (rms) range seem to cause obvious avoidance behavior in a substantial fraction of the animals exposed (see review in Southall *et al.* 2007). In many areas, seismic pulses diminish to these levels at distances ranging from 4–15 km from the source. A substantial proportion of the baleen whales within such distances may show avoidance or other strong disturbance reactions to the operating airgun array. However, in other situations, various mysticetes tolerate exposure to full-scale airgun arrays operating at even closer distances, with only localized avoidance and minor changes in activities. At the other extreme, in migrating bowhead whales, avoidance often extends to considerably larger distances (20–30 km) and lower received sound levels (120–130 dB re 1 μPa (rms)). Also, even in cases where there is no conspicuous avoidance or change in activity upon exposure to sound pulses from distant seismic operations, there are sometimes subtle changes in behavior (*e.g.,* surfacing-respiration-dive cycles) that are only evident through detailed statistical analysis (*e.g.,* Richardson *et al.* 1986; Gailey *et al.* 2007).

Data on short-term reactions by cetaceans to impulsive noises are not necessarily indicative of long-term or biologically significant effects. It is not known whether impulsive sounds affect reproductive rate or distribution and habitat use in subsequent days or years. However, gray whales have continued to migrate annually along the west coast of North America despite intermittent seismic exploration (and much ship traffic) in that area for decades (Appendix A in Malme *et al.* 1984; Richardson *et al.* 1995), and there has been a substantial increase in the population over recent decades (Allen and Angliss 2010). The western Pacific gray whale population did not seem affected by a seismic survey in its feeding ground during a prior year (Johnson *et al.* 2007). Similarly, bowhead whales have continued to travel to the eastern Beaufort Sea each summer despite seismic exploration in their summer and autumn range for many years (Richardson *et al.* 1987), and their numbers have increased notably (Allen and Angliss 2010). Bowheads also have been observed over periods of days or weeks in areas ensonified repeatedly by seismic pulses (Richardson *et al.* 1987; Harris *et al.* 2007). However, it is generally not known whether the same individual bowheads were involved in these repeated observations (within and between years) in strongly ensonified areas. In any event, in the absence of some unusual circumstances, the history of coexistence between seismic surveys and baleen whales suggests that brief exposures to sound pulses from any single seismic survey are unlikely to result in prolonged effects.

Odontocete: Little systematic information is available about reactions of toothed whales to airgun pulses. Few studies similar to the more extensive baleen whale/seismic pulse work summarized above have been reported for toothed whales. However, there are recent systematic data on sperm whales (*e.g.,* Gordon *et al.* 2006; Madsen *et al.* 2006; Winsor and Mate 2006; Jochens *et al.* 2008; Miller *et al.* 2009). There is also an increasing amount of information about responses of various odontocetes to seismic surveys based on monitoring studies (*e.g.,* Stone 2003; Smultea *et al.* 2004; Moulton and Miller 2005; Bain and Williams 2006; Holst *et al.* 2006; Stone and Tasker 2006; Potter *et al.* 2007; Hauser *et al.* 2008; Holst and Smultea 2008; Weir 2008; Barkaszi *et al.* 2009; Richardson *et al.* 2009).

Dolphins and porpoises are often seen by observers on active seismic vessels, occasionally at close distances (*e.g.,* bow riding). However, some studies near the U.K., Newfoundland and Angola, in the Gulf of Mexico, and off Central America have shown localized avoidance. Also, belugas summering in the Canadian Beaufort Sea showed larger-scale avoidance, tending to avoid waters out to 10–20 km from operating seismic vessels. In contrast, recent studies show little evidence of conspicuous reactions by sperm whales to airgun pulses, contrary to earlier indications.

There are almost no specific data on responses of beaked whales to seismic surveys, but it is likely that most if not all species show strong avoidance. There is increasing evidence that some beaked whales may strand after exposure to strong noise from tactical military mid-frequency sonars. Whether they ever do so in response to seismic survey noise is unknown. Northern bottlenose whales seem to continue to call when exposed to pulses from distant seismic vessels.

For delphinids, and possibly the Dall's porpoise, the available data suggest that a ≥170 dB re 1 μPa (rms) disturbance criterion (rather than ≥160 dB) would be appropriate. With a medium-to-large airgun array, received levels typically diminish to 170 dB within 1–4 km, whereas levels typically remain above 160 dB out to 4–15 km (*e.g.,* Tolstoy *et al.* 2009). Reaction distances for delphinids are more consistent with the typical 170 dB re 1 μPa rms distances.

Due to their relatively higher frequency hearing ranges when compared to mysticetes, odontocetes may have stronger responses to mid- and high-frequency sources such as sub-bottom profilers, side scan sonar, and echo sounders than mysticetes (Richardson *et al.* 1995; Southall *et al.* 2007).

Pinnipeds: Few studies of the reactions of pinnipeds to noise from open-water seismic exploration have been published (for review of the early literature, see Richardson *et al.* 1995). However, pinnipeds have been observed during a number of seismic monitoring studies. Monitoring in the Beaufort Sea during 1996–2002 provided a substantial amount of information on avoidance responses (or lack thereof) and associated behavior. Additional monitoring of that type has been done in the Beaufort and Chukchi Seas in 2006–2009. Pinnipeds exposed to seismic surveys have also been observed

during seismic surveys along the U.S. west coast. Some limited data are available on physiological responses of pinnipeds exposed to seismic sound, as studied with the aid of radio telemetry. Also, there are data on the reactions of pinnipeds to various other related types of impulsive sounds.

Early observations provided considerable evidence that pinnipeds are often quite tolerant of strong pulsed sounds. During seismic exploration off Nova Scotia, gray seals exposed to noise from airguns and linear explosive charges reportedly did not react strongly (J. Parsons in Greene *et al.* 1985). An airgun caused an initial startle reaction among South African fur seals but was ineffective in scaring them away from fishing gear. Pinnipeds in both water and air sometimes tolerate strong noise pulses from non-explosive and explosive scaring devices, especially if attracted to the area for feeding or reproduction (Mate and Harvey 1987; Reeves *et al.* 1996). Thus, pinnipeds are expected to be rather tolerant of, or to habituate to, repeated underwater sounds from distant seismic sources, at least when the animals are strongly attracted to the area.

In summary, visual monitoring from seismic vessels has shown only slight (if any) avoidance of airguns by pinnipeds, and only slight (if any) changes in behavior. These studies show that many pinnipeds do not avoid the area within a few hundred meters of an operating airgun array. However, based on the studies with large sample size, or observations from a separate monitoring vessel, or radio telemetry, it is apparent that some phocid seals do show localized avoidance of operating airguns. The limited nature of this tendency for avoidance is a concern. It suggests that one cannot rely on pinnipeds to move away, or to move very far away, before received levels of sound from an approaching seismic survey vessel approach those that may cause hearing impairment.

(3) Masking

Chronic exposure to excessive, though not high-intensity, noise could cause masking at particular frequencies for marine mammals that utilize sound for vital biological functions. Masking can interfere with detection of acoustic signals such as communication calls, echolocation sounds, and environmental sounds important to marine mammals. Since marine mammals depend on acoustic cues for vital biological functions, such as orientation, communication, finding prey, and avoiding predators, marine mammals that experience severe acoustic masking will have reduced fitness in survival and reproduction.

Masking occurs when noise and signals (that animal utilizes) overlap at both spectral and temporal scales. For the airgun noise generated from the proposed marine seismic survey, these are low frequency (under 1 kHz) pulses with extremely short durations (in the scale of milliseconds). Lower frequency man-made noises are more likely to affect detection of communication calls and other potentially important natural sounds such as surf and prey noise. There is little concern regarding masking due to the brief duration of these pulses and relatively longer silence between airgun shots (9–12 seconds) near the noise source, however, at long distances (over tens of kilometers away) in deep water, due to multipath propagation and reverberation, the durations of airgun pulses can be "stretched" to seconds with long decays (Madsen *et al.* 2006; Clark and Gagnon 2006). Therefore it could affect communication signals used by low frequency mysticetes when they occur near the noise band and thus reduce the communication space of animals (*e.g.,* Clark *et al.* 2009a, 2009b) and cause increased stress levels (*e.g.,* Foote *et al.* 2004; Holt *et al.* 2009). Further, in areas of shallow water, multipath propagation of airgun pulses could be more profound, thus affecting communication signals from marine mammals even at close distances. Although average ambient noise in areas where received seismic noises are heard can be elevated at long distances, the intensity of the noise is also greatly reduced at such long distances. Nevertheless, partial informational and energetic masking of different degrees could affect signal receiving in some marine mammals within the ensonified areas. Additional research is needed to further address these effects.

Although masking effects of pulsed sounds on marine mammal calls and other natural sounds are expected to be limited, there are few specific studies on this. Some whales continue calling in the presence of seismic pulses and whale calls often can be heard between the seismic pulses (*e.g.,* Richardson *et al.* 1986; McDonald *et al.* 1995; Greene *et al.* 1999a, 1999b; Nieukirk *et al.* 2004; Smultea *et al.* 2004; Holst *et al.* 2005a, 2005b, 2006; Dunn and Hernandez 2009). However, there is one recent summary report indicating that calling fin whales distributed in one part of the North Atlantic went silent for an extended period starting soon after the onset of a seismic survey in the area (Clark and Gagnon 2006). It is not clear from that preliminary paper whether the whales ceased calling because of masking, or whether this was a behavioral response not directly involving masking. Also, bowhead whales in the Beaufort Sea may decrease their call rates in response to seismic operations, although movement out of the area might also have contributed to the lower call detection rate (Blackwell *et al.* 2009a; 2009b).

Among the odontocetes, there has been one report that sperm whales ceased calling when exposed to pulses from a very distant seismic ship (Bowles *et al.* 1994). However, more recent studies of sperm whales found that they continued calling in the presence of seismic pulses (Madsen *et al.* 2002; Tyack *et al.* 2003; Smultea *et al.* 2004; Holst *et al.* 2006; Jochens *et al.* 2008). Madsen *et al.* (2006) noted that airgun sounds would not be expected to mask sperm whale calls given the intermittent nature of airgun pulses. Dolphins and porpoises are also commonly heard calling while airguns are operating (Gordon *et al.* 2004; Smultea *et al.* 2004; Holst *et al.* 2005a, 2005b; Potter *et al.* 2007). Masking effects of seismic pulses are expected to be negligible in the case of the smaller odontocetes, given the intermittent nature of seismic pulses plus the fact that sounds important to them are predominantly at much higher frequencies than are the dominant components of airgun sounds.

Pinnipeds have best hearing sensitivity and/or produce most of their sounds at frequencies higher than the dominant components of airgun sound, but there is some overlap in the frequencies of the airgun pulses and the calls. However, the intermittent nature of airgun pulses presumably reduces the potential for masking.

Marine mammals are thought to be able to compensate for masking by adjusting their acoustic behavior such as shifting call frequencies, increasing call volume and vocalization rates. For example, blue whales are found to increase call rates when exposed to seismic survey noise in the St. Lawrence Estuary (Di Iorio and Clark 2009). The North Atlantic right whales (*Eubalaena glacialis*) exposed to high shipping noise increase call frequency (Parks *et al.* 2007), while some humpback whales respond to low-frequency active sonar playbacks by increasing song length (Miller *el al.* 2000).

(4) Hearing Impairment

Marine mammals exposed to high intensity sound repeatedly or for prolonged periods can experience hearing threshold shift (TS), which is the loss of hearing sensitivity at certain frequency ranges (Kastak *et al.* 1999;

Schlundt *et al.* 2000; Finneran *et al.* 2002; 2005). TS can be permanent (PTS), in which case the loss of hearing sensitivity is unrecoverable, or temporary (TTS), in which case the animal's hearing threshold will recover over time (Southall *et al.* 2007). Just like masking, marine mammals that suffer from PTS or TTS will have reduced fitness in survival and reproduction, either permanently or temporarily. Repeated noise exposure that leads to TTS could cause PTS. For transient sounds, the sound level necessary to cause TTS is inversely related to the duration of the sound.

TTS is the mildest form of hearing impairment that can occur during exposure to a strong sound (Kryter 1985). While experiencing TTS, the hearing threshold rises and a sound must be stronger in order to be heard. It is a temporary phenomenon, and (especially when mild) is not considered to represent physical damage or "injury" (Southall *et al.* 2007). Rather, the onset of TTS is an indicator that, if the animal is exposed to higher levels of that sound, physical damage is ultimately a possibility.

The magnitude of TTS depends on the level and duration of noise exposure, and to some degree on frequency, among other considerations (Kryter 1985; Richardson *et al.* 1995; Southall *et al.* 2007). For sound exposures at or somewhat above the TTS threshold, hearing sensitivity recovers rapidly after exposure to the noise ends. In terrestrial mammals, TTS can last from minutes or hours to (in cases of strong TTS) days. Only a few data have been obtained on sound levels and durations necessary to elicit mild TTS in marine mammals (none in mysticetes), and none of the published data concern TTS elicited by exposure to multiple pulses of sound during operational seismic surveys (Southall *et al.* 2007).

For toothed whales, experiments on a bottlenose dolphin (*Tursiops truncates*) and beluga whale showed that exposure to a single watergun impulse at a received level of 207 kPa (or 30 psi) peak-to-peak (p-p), which is equivalent to 228 dB re 1 μPa (p-p), resulted in a 7 and 6 dB TTS in the beluga whale at 0.4 and 30 kHz, respectively. Thresholds returned to within 2 dB of the pre-exposure level within 4 minutes of the exposure (Finneran *et al.* 2002). No TTS was observed in the bottlenose dolphin.

Finneran *et al.* (2005) further examined the effects of tone duration on TTS in bottlenose dolphins. Bottlenose dolphins were exposed to 3 kHz tones (non-impulsive) for periods of 1, 2, 4 or 8 seconds (s), with hearing tested at 4.5 kHz. For 1-s exposures, TTS occurred with SELs of 197 dB, and for exposures >1 s, SEL >195 dB resulted in TTS (SEL is equivalent to energy flux, in dB re 1 μPa^2-s). At an SEL of 195 dB, the mean TTS (4 min after exposure) was 2.8 dB. Finneran *et al.* (2005) suggested that an SEL of 195 dB is the likely threshold for the onset of TTS in dolphins and belugas exposed to tones of durations 1–8 s (*i.e.,* TTS onset occurs at a near-constant SEL, independent of exposure duration). That implies that, at least for non-impulsive tones, a doubling of exposure time results in a 3 dB lower TTS threshold.

However, the assumption that, in marine mammals, the occurrence and magnitude of TTS is a function of cumulative acoustic energy (SEL) is probably an oversimplification. Kastak *et al.* (2005) reported preliminary evidence from pinnipeds that, for prolonged non-impulse noise, higher SELs were required to elicit a given TTS if exposure duration was short than if it was longer, i.e., the results were not fully consistent with an equal-energy model to predict TTS onset. Mooney *et al.* (2009a) showed this in a bottlenose dolphin exposed to octave-band non-impulse noise ranging from 4 to 8 kHz at SPLs of 130 to 178 dB re 1 μPa for periods of 1.88 to 30 minutes (min). Higher SELs were required to induce a given TTS if exposure duration was short than if it was longer. Exposure of the aforementioned bottlenose dolphin to a sequence of brief sonar signals showed that, with those brief (but non-impulse) sounds, the received energy (SEL) necessary to elicit TTS was higher than was the case with exposure to the more prolonged octave-band noise (Mooney et al. 2009b). Those authors concluded that, when using (non-impulse) acoustic signals of duration 0.5 s, SEL must be at least 210–214 dB re 1 μPa2-s to induce TTS in the bottlenose dolphin. The most recent studies conducted by Finneran *et al.* also support the notion that exposure duration has a more significant influence compared to SPL as the duration increases, and that TTS growth data are better represented as functions of SPL and duration rather than SEL alone (Finneran *et al.* 2010a, 2010b). In addition, Finneran *et al.* (2010b) conclude that when animals are exposed to intermittent noises, there is recovery of hearing during the quiet intervals between exposures through the accumulation of TTS across multiple exposures. Such findings suggest that when exposed to multiple seismic pulses, partial hearing recovery also occurs during the seismic pulse intervals.

For baleen whales, there are no data, direct or indirect, on levels or properties of sound that are required to induce TTS. The frequencies to which baleen whales are most sensitive are lower than those to which odontocetes are most sensitive, and natural ambient noise levels at those low frequencies tend to be higher (Urick 1983). As a result, auditory thresholds of baleen whales within their frequency band of best hearing are believed to be higher (less sensitive) than are those of odontocetes at their best frequencies (Clark and Ellison 2004). From this, it is suspected that received levels causing TTS onset may also be higher in baleen whales. However, no cases of TTS are expected given the small size of the airguns proposed to be used and the strong likelihood that baleen whales (especially migrating bowheads) would avoid the approaching airguns (or vessel) before being exposed to levels high enough for there to be any possibility of TTS.

In pinnipeds, TTS thresholds associated with exposure to brief pulses (single or multiple) of underwater sound have not been measured. Initial evidence from prolonged exposures suggested that some pinnipeds may incur TTS at somewhat lower received levels than do small odontocetes exposed for similar durations (Kastak *et al.* 1999; 2005). However, more recent indications are that TTS onset in the most sensitive pinniped species studied (harbor seal, which is closely related to the ringed seal) may occur at a similar SEL as in odontocetes (Kastak *et al.* 2004).

Most cetaceans show some degree of avoidance of seismic vessels operating an airgun array (see above). It is unlikely that these cetaceans would be exposed to airgun pulses at a sufficiently high level for a sufficiently long period to cause more than mild TTS, given the relative movement of the vessel and the marine mammal. TTS would be more likely in any odontocetes that bow- or wake-ride or otherwise linger near the airguns. However, while bow- or wake-riding, odontocetes would be at the surface and thus not exposed to strong sound pulses given the pressure release and Lloyd Mirror effects at the surface. But if bow- or wake-riding animals were to dive intermittently near airguns, they would be exposed to strong sound pulses, possibly repeatedly.

If some cetaceans did incur mild or moderate TTS through exposure to airgun sounds in this manner, this would very likely be a temporary and

reversible phenomenon. However, even a temporary reduction in hearing sensitivity could be deleterious in the event that, during that period of reduced sensitivity, a marine mammal needed its full hearing sensitivity to detect approaching predators, or for some other reason.

Some pinnipeds show avoidance reactions to airguns, but their avoidance reactions are generally not as strong or consistent as those of cetaceans. Pinnipeds occasionally seem to be attracted to operating seismic vessels. There are no specific data on TTS thresholds of pinnipeds exposed to single or multiple low-frequency pulses. However, given the indirect indications of a lower TTS threshold for the harbor seal than for odontocetes exposed to impulse sound (see above), it is possible that some pinnipeds close to a large airgun array could incur TTS.

Current NMFS' noise exposure standards require that cetaceans and pinnipeds should not be exposed to pulsed underwater noise at received levels exceeding, respectively, 180 and 190 dB re 1 µPa (rms). These criteria were taken from recommendations by an expert panel of the High Energy Seismic Survey (HESS) Team that performed an assessment on noise impacts by seismic airguns to marine mammals in 1997, although the HESS Team recommended a 180-dB limit for pinnipeds in California (HESS 1999). The 180 and 190 dB re 1 µPa (rms) levels have not been considered to be the levels above which TTS might occur. Rather, they were the received levels above which, in the view of a panel of bioacoustics specialists convened by NMFS before TTS measurements for marine mammals started to become available, one could not be certain that there would be no injurious effects, auditory or otherwise, to marine mammals. As summarized above, data that are now available imply that TTS is unlikely to occur in various odontocetes (and probably mysticetes as well) unless they are exposed to a sequence of several airgun pulses stronger than 190 dB re 1 µPa (rms). On the other hand, for the harbor seal, harbor porpoise, and perhaps some other species, TTS may occur upon exposure to one or more airgun pulses whose received level equals the NMFS "do not exceed" value of 190 dB re 1 µPa (rms). That criterion corresponds to a single-pulse SEL of 175–180 dB re 1 μPa^2-s in typical conditions, whereas TTS is suspected to be possible in harbor seals and harbor porpoises with a cumulative SEL of ~171 and ~164 dB re 1 μPa^2-s, respectively.

It has been shown that most large whales and many smaller odontocetes (especially the harbor porpoise) show at least localized avoidance of ships and/or seismic operations. Even when avoidance is limited to the area within a few hundred meters of an airgun array, that should usually be sufficient to avoid TTS based on what is currently known about thresholds for TTS onset in cetaceans. In addition, ramping up airgun arrays, which is standard operational protocol for many seismic operators, should allow cetaceans near the airguns at the time of startup (if the sounds are aversive) to move away from the seismic source and to avoid being exposed to the full acoustic output of the airgun array. Thus, most baleen whales likely will not be exposed to high levels of airgun sounds provided the ramp-up procedure is applied. Likewise, many odontocetes close to the trackline are likely to move away before the sounds from an approaching seismic vessel become sufficiently strong for there to be any potential for TTS or other hearing impairment. Hence, there is little potential for baleen whales or odontocetes that show avoidance of ships or airguns to be close enough to an airgun array to experience TTS. Therefore, it is not likely that marine mammals in the vicinity of the proposed open water marine and seismic surveys by Shell and Statoil would experience TTS as a result of these activities.

PTS

When PTS occurs, there is physical damage to the sound receptors in the ear. In some cases, there can be total or partial deafness, whereas in other cases, the animal has an impaired ability to hear sounds in specific frequency ranges (Kryter 1985). Physical damage to a mammal's hearing apparatus can occur if it is exposed to sound impulses that have very high peak pressures, especially if they have very short rise times. (Rise time is the interval required for sound pressure to increase from the baseline pressure to peak pressure.)

There is no specific evidence that exposure to pulses of airgun sound can cause PTS in any marine mammal, even with large arrays of airguns. However, given the likelihood that some mammals close to an airgun array might incur at least mild TTS (see above), there has been further speculation about the possibility that some individuals occurring very close to airguns might incur PTS (*e.g.,* Richardson *et al.* 1995; Gedamke *et al.* 2008). Single or occasional occurrences of mild TTS are not indicative of permanent auditory damage, but repeated or (in some cases) single exposures to a level well above that causing TTS onset might elicit PTS.

Relationships between TTS and PTS thresholds have not been studied in marine mammals, but are assumed to be similar to those in humans and other terrestrial mammals (Southall *et al.* 2007). Based on data from terrestrial mammals, a precautionary assumption is that the PTS threshold for impulse sounds (such as airgun pulses as received close to the source) is at least 6 dB higher than the TTS threshold on a peak-pressure basis, and probably > 6 dB higher (Southall *et al.* 2007). The low-to-moderate levels of TTS that have been induced in captive odontocetes and pinnipeds during controlled studies of TTS have been confirmed to be temporary, with no measurable residual PTS (Kastak *et al.* 1999; Schlundt *et al.* 2000; Finneran *et al.* 2002; 2005; Nachtigall *et al.* 2003; 2004). However, very prolonged exposure to sound strong enough to elicit TTS, or shorter-term exposure to sound levels well above the TTS threshold, can cause PTS, at least in terrestrial mammals (Kryter 1985). In terrestrial mammals, the received sound level from a single non-impulsive sound exposure must be far above the TTS threshold for any risk of permanent hearing damage (Kryter 1994; Richardson *et al.* 1995; Southall *et al.* 2007). However, there is special concern about strong sounds whose pulses have very rapid rise times. In terrestrial mammals, there are situations when pulses with rapid rise times (*e.g.,* from explosions) can result in PTS even though their peak levels are only a few dB higher than the level causing slight TTS. The rise time of airgun pulses is fast, but not as fast as that of an explosion.

Some factors that contribute to onset of PTS, at least in terrestrial mammals, are as follows:

- Exposure to single very intense sound,
- Fast rise time from baseline to peak pressure,
- Repetitive exposure to intense sounds that individually cause TTS but not PTS, and
- Recurrent ear infections or (in captive animals) exposure to certain drugs.

Cavanagh (2000) reviewed the thresholds used to define TTS and PTS. Based on this review and SACLANT (1998), it is reasonable to assume that PTS might occur at a received sound level 20 dB or more above that inducing mild TTS. However, for PTS to occur at a received level only 20 dB above the TTS threshold, the animal probably would have to be exposed to a strong

sound for an extended period, or to a strong sound with rather rapid rise time.

More recently, Southall *et al.* (2007) estimated that received levels would need to exceed the TTS threshold by at least 15 dB, on an SEL basis, for there to be risk of PTS. Thus, for cetaceans exposed to a sequence of sound pulses, they estimate that the PTS threshold might be an M-weighted SEL (for the sequence of received pulses) of ~198 dB re 1 μPa^2-s. Additional assumptions had to be made to derive a corresponding estimate for pinnipeds, as the only available data on TTS thresholds in pinnipeds pertained to nonimpulse sound (see above). Southall *et al.* (2007) estimated that the PTS threshold could be a cumulative SEL of ~186 dB re 1 μPa^2-s in the case of a harbor seal exposed to impulse sound. The PTS threshold for the California sea lion and northern elephant seal would probably be higher given the higher TTS thresholds in those species. Southall *et al.* (2007) also note that, regardless of the SEL, there is concern about the possibility of PTS if a cetacean or pinniped received one or more pulses with peak pressure exceeding 230 or 218 dB re 1 µPa, respectively. Thus, PTS might be expected upon exposure of cetaceans to either SEL ≥ 198 dB re 1 µPa2-s or peak pressure ≥ 230 dB re 1 µPa. Corresponding proposed dual criteria for pinnipeds (at least harbor seals) are ≥ 186 dB SEL and ≥ 218 dB peak pressure (Southall *et al.* 2007). These estimates are all first approximations, given the limited underlying data, assumptions, species differences, and evidence that the "equal energy" model may not be entirely correct.

Sound impulse duration, peak amplitude, rise time, number of pulses, and inter-pulse interval are the main factors thought to determine the onset and extent of PTS. Ketten (1994) has noted that the criteria for differentiating the sound pressure levels that result in PTS (or TTS) are location and species specific. PTS effects may also be influenced strongly by the health of the receiver's ear.

As described above for TTS, in estimating the amount of sound energy required to elicit the onset of TTS (and PTS), it is assumed that the auditory effect of a given cumulative SEL from a series of pulses is the same as if that amount of sound energy were received as a single strong sound. There are no data from marine mammals concerning the occurrence or magnitude of a potential partial recovery effect between pulses. In deriving the estimates of PTS (and TTS) thresholds quoted here, Southall *et al.* (2007) made the precautionary assumption that no recovery would occur between pulses.

It is unlikely that an odontocete would remain close enough to a large airgun array for sufficiently long to incur PTS. There is some concern about bowriding odontocetes, but for animals at or near the surface, auditory effects are reduced by Lloyd's mirror and surface release effects. The presence of the vessel between the airgun array and bow-riding odontocetes could also, in some but probably not all cases, reduce the levels received by bow-riding animals (*e.g.,* Gabriele and Kipple 2009). The TTS (and thus PTS) thresholds of baleen whales are unknown but, as an interim measure, assumed to be no lower than those of odontocetes. Also, baleen whales generally avoid the immediate area around operating seismic vessels, so it is unlikely that a baleen whale could incur PTS from exposure to airgun pulses. The TTS (and thus PTS) thresholds of some pinnipeds (*e.g.,* harbor seal) as well as the harbor porpoise may be lower (Kastak *et al.* 2005; Southall *et al.* 2007; Lucke *et al.* 2009). If so, TTS and potentially PTS may extend to a somewhat greater distance for those animals. Again, Lloyd's mirror and surface release effects will ameliorate the effects for animals at or near the surface.

(5) Non-Auditory Physical Effects

Non-auditory physical effects might occur in marine mammals exposed to strong underwater pulsed sound. Possible types of non-auditory physiological effects or injuries that theoretically might occur in mammals close to a strong sound source include stress, neurological effects, bubble formation, and other types of organ or tissue damage. Some marine mammal species (*i.e.,* beaked whales) may be especially susceptible to injury and/or stranding when exposed to intense sounds. However, there is no definitive evidence that any of these effects occur even for marine mammals in close proximity to large arrays of airguns, and beaked whales do not occur in the proposed project area. In addition, marine mammals that show behavioral avoidance of seismic vessels, including most baleen whales, some odontocetes (including belugas), and some pinnipeds, are especially unlikely to incur non-auditory impairment or other physical effects.

Therefore, it is unlikely that such effects would occur during Statoil's proposed surveys given the brief duration of exposure and the planned monitoring and mitigation measures described later in this document.

Additional non-auditory effects, while not direct physical impacts, include elevated levels of stress response (Wright *et al.* 2007; Wright and Highfill 2007). Although not many studies have been done on noise-induced stress in marine mammals, extrapolation of information regarding stress responses in other species seems appropriate because the responses are highly consistent among all species in which they have been examined to date (Wright *et al.* 2007). Therefore, it is reasonable to conclude that noise acts as a stressor to marine mammals. Furthermore, given that marine mammals will likely respond in a manner consistent with other species studied, repeated and prolonged exposures to stressors (including or induced by noise) will be problematic for marine mammals of all ages. Wright *et al.* (2007) state that a range of issues may arise from the extended stress response including, but not limited to, suppression of reproduction (physiologically and behaviorally), accelerated aging and sickness-like symptoms.

(6) Stranding and Mortality

Marine mammals close to underwater detonations of high explosive can be killed or severely injured, and the auditory organs are especially susceptible to injury (Ketten *et al.* 1993; Ketten 1995). Airgun pulses are less energetic and their peak amplitudes have slower rise times, while stranding and mortality events would include other energy sources (acoustical or shock wave) far beyond just seismic airguns. To date, there is no evidence that serious injury, death, or stranding by marine mammals can occur from exposure to airgun pulses, even in the case of large airgun arrays.

However, in numerous past IHA notices for seismic surveys, commenters have referenced two stranding events allegedly associated with seismic activities, one off Baja California and a second off Brazil. NMFS has addressed this concern several times, and, without new information, does not believe that this issue warrants further discussion. For information relevant to strandings of marine mammals, readers are encouraged to review NMFS' response to comments on this matter found in 69 FR 74906 (December 14, 2004), 71 FR 43112 (July 31, 2006), 71 FR 50027 (August 24, 2006), and 71 FR 49418 (August 23, 2006). In addition, a May-June 2008, stranding of 100–200 melon-headed whales (*Peponocephala electra*) off Madagascar that appears to be associated with seismic surveys is

currently under investigation (IWC 2009).

It should be noted that strandings related to sound exposure have not been recorded for marine mammal species in the Beaufort and Chukchi seas. NMFS notes that in the Beaufort Sea, aerial surveys have been conducted by MMS and industry during periods of industrial activity (and by MMS during times with no activity). No strandings or marine mammals in distress have been observed during these surveys and none have been reported by North Slope Borough inhabitants. In addition, there are very few instances demonstrating that seismic surveys in general have been linked to marine mammal strandings, other than those mentioned above. As a result, NMFS does not expect any marine mammals will incur serious injury or mortality in the Arctic Ocean or strand as a result of proposed seismic survey.

Vessel Sounds

In addition to the noise generated from seismic airguns and active sonar systems, various types of vessels will be used in the operations, including source vessels and support vessels. Sounds from boats and vessels have been reported extensively (Greene and Moore 1995; Blackwell and Greene 2002; 2005; 2006). Numerous measurements of underwater vessel sound have been performed in support of recent industry activity in the Chukchi and Beaufort Seas. Results of these measurements have been reported in various 90-day and comprehensive reports since 2007 (*e.g.,* Aerts *et al.* 2008; Hauser *et al.* 2008; Brueggeman 2009; Ireland *et al.* 2009). For example, Garner and Hannay (2009) estimated sound pressure levels of 100 dB at distances ranging from approximately 1.5 to 2.3 mi (2.4 to 3.7 km) from various types of barges. MacDonald *et al.* (2008) estimated higher underwater SPLs from the seismic vessel *Gilavar* of 120 dB at approximately 13 mi (21 km) from the source, although the sound level was only 150 dB at 85 ft (26 m) from the vessel. Compared to airgun pulses, underwater sound from vessels is generally at relatively low frequencies.

The primary sources of sounds from all vessel classes are propeller cavitation, propeller singing, and propulsion or other machinery. Propeller cavitation is usually the dominant noise source for vessels (Ross 1976). Propeller cavitation and singing are produced outside the hull, whereas propulsion or other machinery noise originates inside the hull. There are additional sounds produced by vessel activity, such as pumps, generators, flow noise from water passing over the hull, and bubbles breaking in the wake. Icebreakers contribute greater sound levels during ice-breaking activities than ships of similar size during normal operation in open water (Richardson *et al.* 1995). This higher sound production results from the greater amount of power and propeller cavitation required when operating in thick ice. Source levels from various vessels would be empirically measured before the start of marine surveys.

Anticipated Effects on Habitat

The primary potential impacts to marine mammals and other marine species are associated with elevated sound levels produced by airguns and other active acoustic sources. However, other potential impacts to the surrounding habitat from physical disturbance are also possible.

Potential Impacts on Prey Species

With regard to fish as a prey source for cetaceans and pinnipeds, fish are known to hear and react to sounds and to use sound to communicate (Tavolga *et al.* 1981) and possibly avoid predators (Wilson and Dill 2002). Experiments have shown that fish can sense both the strength and direction of sound (Hawkins, 1981). Primary factors determining whether a fish can sense a sound signal, and potentially react to it, are the frequency of the signal and the strength of the signal in relation to the natural background noise level.

The level of sound at which a fish will react or alter its behavior is usually well above the detection level. Fish have been found to react to sounds when the sound level increased to about 20 dB above the detection level of 120 dB (Ona 1988); however, the response threshold can depend on the time of year and the fish's physiological condition (Engas *et al.* 1993). In general, fish react more strongly to pulses of sound rather than a continuous signal (Blaxter *et al.* 1981), and a quicker alarm response is elicited when the sound signal intensity rises rapidly compared to sound rising more slowly to the same level.

Investigations of fish behavior in relation to vessel noise (Olsen *et al.* 1983; Ona 1988; Ona and Godo 1990) have shown that fish react when the sound from the engines and propeller exceeds a certain level. Avoidance reactions have been observed in fish such as cod and herring when vessels approached close enough that received sound levels are 110 dB to 130 dB (Nakken 1992; Olsen 1979; Ona and Godo 1990; Ona and Toresen 1988). However, other researchers have found that fish such as polar cod, herring, and capeline are often attracted to vessels (apparently by the noise) and swim toward the vessel (Rostad *et al.* 2006). Typical sound source levels of vessel noise in the audible range for fish are 150 dB to 170 dB (Richardson *et al.* 1995).

Some mysticetes, including bowhead whales, feed on concentrations of zooplankton. Some feeding bowhead whales may occur in the Alaskan Beaufort Sea in July and August, and others feed intermittently during their westward migration in September and October (Richardson and Thomson [eds.] 2002; Lowry *et al.* 2004). Reactions of zooplanktoners to sound are, for the most part, not known. Their abilities to move significant distances are limited or nil, depending on the type of animal. A reaction by zooplankton to sounds produced by the marine survey program would only be relevant to whales if it caused concentrations of zooplankton to scatter. Pressure changes of sufficient magnitude to cause that type of reaction would probably occur only near the airgun source, which is expected to be a very small area. Impacts on zooplankton behavior are predicted to be negligible, and that would translate into negligible impacts on feeding mysticetes.

Estimated Take by Incidental Harassment

Except with respect to certain activities not pertinent here, the MMPA defines "harassment" as: Any act of pursuit, torment, or annoyance which (i) has the potential to injure a marine mammal or marine mammal stock in the wild [Level A harassment]; or (ii) has the potential to disturb a marine mammal or marine mammal stock in the wild by causing disruption of behavioral patterns, including, but not limited to, migration, breathing, nursing, breeding, feeding, or sheltering [Level B harassment]. Only take by Level B behavioral harassment is anticipated as a result of the proposed open water seismic survey program. Anticipated impacts to marine mammals are associated with noise propagation from the seismic airgun(s) used in the seismic survey.

The full suite of potential impacts to marine mammals was described in detail in the "Potential Effects of the Specified Activity on Marine Mammals" section found earlier in this document. The potential effects of sound from the proposed open water marine survey programs might include one or more of the following: Tolerance; masking of natural sounds; behavioral disturbance; non-auditory physical effects; and, at

least in theory, temporary or permanent hearing impairment (Richardson *et al.* 1995). As discussed earlier in this document, the most common impact will likely be from behavioral disturbance, including avoidance of the ensonified area or changes in speed, direction, and/or diving profile of the animal. For reasons discussed previously in this document, hearing impairment (TTS and PTS) are highly unlikely to occur based on the proposed mitigation and monitoring measures that would preclude marine mammals being exposed to noise levels high enough to cause hearing impairment.

For impulse sounds, such as those produced by airgun(s) used in the seismic survey, NMFS uses the 160 dB re 1 μPa (rms) isopleth to indicate the onset of Level B harassment. Statoil provided calculations for the 160-dB isopleths produced by these active acoustic sources and then used those isopleths to estimate takes by harassment. NMFS used the calculations to make the necessary MMPA preliminary findings. Statoil provided a full description of the methodology used to estimate takes by harassment in its IHA application (*see* **ADDRESSES**), which is also provided in the following sections.

Statoil has requested an authorization to take 13 marine mammal species by Level B harassment. These 13 marine mammal species are: Beluga whale (*Delphinapterus leucas*), narwhal (*Monodon monoceros*), killer whale (*Orcinus orca*), harbor porpoise (*Phocoena phocoena*), bowhead whale (*Balaena mysticetus*), gray whale (*Eschrichtius robustus*), humpback whale (*Megaptera novaeangliae*), minke whale (*Balaenoptera acutorostrata*), fin whale (*B. physalus*), bearded seal (*Erignathus barbatus*), ringed seal (*Phoca hispida*), spotted seal (*P. largha*), and ribbon seal (*Histriophoca fasciata*). However, NMFS believes that narwhals are not likely to occur in the proposed survey area during the time of the proposed marine seismic survey. Therefore, NMFS believes that only the other 12 marine mammal species could potentially be taken by Level B behavioral harassment as a result of the proposed marine surveys.

Basis for Estimating "Take by Harassment"

As stated previously, it is current NMFS policy to estimate take by Level B harassment for impulse sounds at a received level of 160 dB re 1μPa (rms). However, not all animals react to sounds at this low level, and many will not show strong reactions (and in some cases any reaction) until sounds are much stronger. Southall *et al.* (2007) provide a severity scale for ranking observed behavioral responses of both free-ranging marine mammals and laboratory subjects to various types of anthropogenic sound (see Table 4 in Southall *et al.* (2007)). Tables 7, 9, and 11 in Southall *et al.* (2007) outline the numbers of low-frequency cetaceans, mid-frequency cetaceans, and pinnipeds in water, respectively, reported as having behavioral responses to multi-pulses in 10-dB received level increments. These tables illustrate that the more severe reactions did not occur until sounds were much higher than 160 dB re 1μPa (rms).

As described earlier in the document, the proposed open water marine seismic survey would use two airgun arrays with a total discharge volume of 3,000 in^3. The modeled 160 dB zone of influence reaches to 13 km from the airgun source. The estimated number of animals potentially harassed was calculated by multiplying the expected densities (in number/km^2) by the anticipated area ensonified by levels of ≥160 dB re 1μPa. Estimates of the number of animals potentially impacted were conducted separately for the 3D survey area and the 2D survey lines. For the 3D survey area, the anticipated area ensonified by sound levels of ≥160 dB was calculated as an area encompassing a 8.1 mi (13 km) radius extending from each point of the survey area perimeter (hereafter called the 160 dB exposed survey area). This approach was taken because closely spaced survey lines and large cross-track distances of the ≥160 dB radii result in repeated exposure of the same area of water. Excessive amounts of repeated exposure leads to an overestimation of the number of animals potentially exposed. For the 2D survey lines the area ensonified by sound levels of ≥160 dB was calculated as the total line kilometers multiplied by 2 times the 8.1 mi (13 km) ≥160 dB safety radius. The following subsections describe in more detail the data and methods used in deriving the estimated number of animals potentially "taken by harassment" during the proposed survey. It provides information on the expected marine mammal densities, estimated distances to received levels of 190, 180, 160, and 120 dB re 1μPa and the calculation of anticipated areas ensonified by levels of ≥160 dB.

It is important to understand that not all published results from visual observations have applied correction factors that account for detectability and availability bias. Detectability bias, quantified in part by f(0), is associated with diminishing sightability with increasing lateral distance from the survey trackline. Availability bias [g(0)] refers to the fact that not all animals are at the surface and that there is therefore <100% probability of sighting an animal that is present along the survey trackline. Some sources below included correction factors in the reported densities (e.g., ringed seals in Bengtson *et al.* 2005) and the best available correction factors were applied to reported results when they had not already been included (*e.g.,* Moore *et al.* 2000b).

(1) Cetaceans

Eight species of cetaceans are known to occur in the Chukchi Sea area of the proposed Statoil project. Only four of these (bowhead, beluga, and gray whales, and harbor porpoise) are likely to be encountered during the proposed survey activities. Three of the eight species (bowhead, fin, and humpback whales) are listed as endangered under the ESA. Of these, only the bowhead is likely to be found within the survey area.

Beluga Whales—Summer densities of beluga in offshore waters are expected to be low. Aerial surveys have recorded few belugas in the offshore Chukchi Sea during the summer months (Moore *et al.* 2000b). Aerial surveys of the Chukchi Sea in 2008–2009 flown by the NMML as part of the Chukchi Offshore Monitoring in Drilling Area project (COMIDA) have only reported 5 beluga sightings during > 8,700 mi (> 14,000 km) of on-transect effort, only 2 of which were offshore (COMIDA 2009). Additionally, only one beluga sighting was recorded during > 37,904 mi (> 61,000 km) of visual effort during good visibility conditions from industry vessels operating in the Chukchi Sea in July–August of 2006–2008 (Haley *et al.* 2009b). If belugas are present during the summer, they are more likely to occur in or near the ice edge or close to shore during their northward migration. Expected densities were calculated from data in Moore *et al.* (2000b). Data from Moore *et al.* (2000b: Figure 6 and Table 6) used as the average open-water density estimate included two on-transect beluga sightings during 6,639 mi (10,684 km) of on-transect effort in the Chukchi Sea during summer. A mean group size of 7.1 (CV = 1.7) was calculated from 10 Chukchi Sea summer sightings present in the BWASP database. A f(0) value of 2.841 and g(0) value of 0.58 from Harwood *et al.* (1996) were also used in the calculation. The CV associated with group size was used to select an inflation factor of 2 to estimate the maximum density that may occur in both open-water and ice-margin habitats. Specific data on the

relative abundance of beluga in open-water versus ice-margin habitat during the summer in the Chukchi Sea is not available. However, Moore *et al.* (2000b) reported higher than expected beluga sighting rates in open-water during fall surveys in the Beaufort and Chukchi Seas. This would suggest that densities near ice may actually be lower than open water, but belugas are commonly associated with ice, so an inflation factor of only 2 (instead of 4) was used to estimate the average ice-margin density from the open-water density. Based on the very low densities observed from vessels operating in the Chukchi Sea during non-seismic periods and locations in July–August of 2006–2008 (0.0001/km^2; Haley *et al.* 2009b), the densities shown in Table 1 are likely biased high.

In the fall, beluga whale densities in the Chukchi Sea are expected to be somewhat higher than in the summer because individuals of the eastern Chukchi Sea stock and the Beaufort Sea stock will be migrating south to their wintering grounds in the Bering Sea (Angliss and Allen 2009). Consistent with this, the number of on-effort beluga sightings reported during COMIDA flights in September–October of 2008–2009 was over 3 times more than during July–August with a very similar amount of on-transect effort (COMIDA 2009). However, there were no beluga sightings reported during >11,185 mi (>18,000 km) of vessel based effort in good visibility conditions during 2006–2008 industry operations in the Chukchi Sea. Densities derived from survey results in the northern Chukchi Sea in Moore *et al.* (2000b) were used as the average density for open-water and ice-margin fall season estimates (see Table 2). Data from Moore *et al.* (2000b: Table 8) used in the average open-water density estimate included 123 beluga sightings and 27,559 mi (44,352 km) of on-transect effort in water depths 118–164 ft (36–50 m). A mean group size of 2.39 (CV = 0.92) came from the average group size of 82 Chukchi Sea fall sightings in waters 115–164 ft (35–50 m) deep present in the BWASP database. A f(0) value of 2.841 and g(0) value of 0.58 from Harwood *et al.* (1996) were used in the calculation. The CV associated with group size was used to select an inflation factor of 2 to estimate the maximum density that may occur in both open-water and ice-margin habitats. Moore *et al.* (2000b) reported higher than expected beluga sighting rates in open-water during fall surveys in the Beaufort and Chukchi seas, so an inflation value of only 2 was used to estimate the average ice-margin density from the open-water density. There were no beluga sightings from vessels operating in the Chukchi Sea during non-seismic periods in September–October of 2006–2008 (Haley *et al.* 2009b).

TABLE 1—EXPECTED DENSITIES OF CETACEANS AND SEALS IN AREAS OF THE CHUKCHI SEA, ALASKA, DURING THE PLANNED SUMMER (JULY–AUGUST) PERIOD OF THE SEISMIC SURVEY PROGRAM

Species	Nearshore	Ice margin
	Average density (#/km^2)	Average density (#/km^2)
Beluga whale	0.0033	0.0162
Killer whale	0.0001	0.0001
Harbor porpoise	0.0011	0.0011
Bowhead whale	0.0018	0.0018
Fin whale	0.0001	0.0001
Gray whale	0.0081	0.0081
Humpback whale	0.0001	0.0001
Minke whale	0.0001	0.0001
Bearded seal	0.0107	0.0142
Ribbon seal	0.0003	0.0003
Ringed seal	0.3668	0.4891
Spotted seal	0.0073	0.0098

TABLE 2—EXPECTED DENSITIES OF CETACEANS AND SEALS IN AREAS OF THE CHUKCHI SEA, ALASKA, DURING THE PLANNED FALL (SEPTEMBER–OCTOBER) PERIOD OF THE SEISMIC SURVEY PROGRAM

Species	Nearshore	Ice margin
	Average density (#/km^2)	Average density (#/km^2)
Beluga whale	0.0162	0.0324
Killer whale	0.0001	0.0001
Harbor porpoise	0.0010	0.0010
Bowhead whale	0.0174	0.0348
Fin whale	0.0001	0.0001
Gray whale	0.0062	0.0062
Humpback whale	0.0001	0.0001
Minke whale	0.0001	0.0001
Bearded seal	0.0107	0.0142
Ribbon seal	0.0003	0.0003
Ringed seal	0.2458	0.3277
Spotted seal	0.0049	0.0065

Bowhead Whales—By July, most bowhead whales are northeast of the Chukchi Sea, within or migrating toward their summer feeding grounds in the eastern Beaufort Sea. No bowheads were reported during 6,639 mi (10,684 km) of on-transect effort in the Chukchi Sea by Moore *et al.* (2000b). Aerial surveys in 2008–2009 by the NMML as part of the COMIDA project reported four sightings during > 8,699 mi (≤14,000 km) of on-transect effort. Two of the four sightings were offshore, both of which occurred near the end of August. Bowhead whales were also rarely reported in July–August of 2006–2008 during aerial surveys of the Chukchi Sea coast (Thomas *et al.* 2009). This is consistent with movements of tagged whales (see ADFG 2009; Quakenbush 2009), all of which moved through the Chukchi Sea by early May 2009, and tended to travel relatively close to shore, especially in the northern Chukchi Sea.

The estimate of bowhead whale density in the Chukchi Sea was calculated by assuming that there was one bowhead sighting during the 6,639 mi (10,684 km) survey effort in the Chukchi Sea during the summer, although no bowheads were actually observed (Moore *et al.* 2000b). The more recent COMIDA data were not used because the NMML has not released a final report summarizing the data. Only two sightings are present in the BWASP database during July and August in the Chukchi Sea, both of which were of individual whales. The mean group size from combined July–August sightings in the BWASP, COMIDA, and 2006–2008 industry database is 1.33 (CV= 0.58). This value, along with a f(0) value of 2 and a g(0) value of 0.07, both from Thomas *et al.* (2002) were used to estimate a summer density of bowhead whales. The CV of group size and standard errors reported in Thomas *et al.* (2002) for f(0) and g(0) correction factors suggest that an inflation factor of 2 is appropriate for deriving a maximum density from the average density. Bowheads are not expected to be encountered in higher densities near ice in the summer (Moore *et al.* 2000b), so the same density estimates are used for open-water and ice-margin habitats. Densities from vessel based surveys in the Chukchi Sea during non-seismic periods and locations in July–August of 2006–2008 (Haley *et al.* 2009b) ranged from 0.0001/km^2 to 0.0005/km^2 with a maximum 95 percent confidence interval (CI) of 0.0019 km^2. This suggests that the densities used in the calculations and shown in Table 1 might be somewhat higher than expected to be observed from vessels near the area of planned operations.

During the fall, bowhead whales migrate west and south from their summer feeding grounds in the Beaufort Sea and Amundsen Gulf to their wintering grounds in the Bering Sea. During this fall migration bowheads are more likely to be encountered in the Chukchi Sea. Moore *et al.* (2000b: Table 8) reported 34 bowhead sightings during 27,560 mi (44,354 km) of on-transect

survey effort in the Chukchi Sea during September–October. Thomas *et al.* (2009) also reported increased sightings on coastal surveys of the Chukchi Sea during September and October of 2006–2008. Aerial surveys in 2008–2009 (COMIDA 2009) reported 20 bowhead sightings during 8,803 mi (14,167 km) of on-transect effort, eight of which were offshore. GPS tagging of bowheads show that migration routes through the Chukchi Sea are more variable than through the Beaufort Sea (ADFG 2009; Quakenbush 2009). Some of the routes taken by bowheads remain well north or south of the planned survey activities while others have passed near to or through the area. Kernel densities estimated from GPS locations of whales suggest that bowheads do not spend much time (e.g., feeding or resting) in the north-central Chukchi Sea near the area of planned activities (ADFG 2009). The mean group size from September–October Chukchi Sea bowhead sightings in the BWASP database is 1.59 (CV=1.08). This is slightly below the mean group size of 1.85 from all the preliminary COMIDA sightings during the same months, but above the value of 1.13 from only on-effort COMIDA sightings (COMIDA 2009). The same f(0) and g(0) values that were used for the summer estimates above were used for the fall estimates. As with the summer estimates, an inflation factor of 2 was used to estimate the maximum density from the average density in both habitat types. Moore *et al.* (2000b) found that bowheads were detected more often than expected in association with ice in the Chukchi Sea in September–October, so a density of twice the average open-water density was used as the average ice-margin density. Densities from vessel based surveys in the Chukchi Sea during non-seismic periods and locations in September–October of 2006–2008 (Haley *et al.* 2009b) ranged from 0.0001/km^2 to 0.0050/km^2 with a maximum 95 percent CI of 0.0480 km^2. This suggests the densities used in the calculations and shown in Table 2 are somewhat higher than are likely to be observed from vessels near the area of planned operations.

Gray Whales—The average open-water summer density was calculated from effort and sightings in Moore *et al.* (2000b: Table 6) for water depths 118–164 ft (36–50 m) including 4 sightings during 3,901 mi (6,278 km) of on-transect effort. An average group size of 3.11 (CV=0.97) was calculated from all July–August Chukchi Sea gray whale sightings in the BWASP database and used in the summer density estimate. This value was higher than the average group size in the preliminary COMIDA data (1.71; COMIDA 2009) and from coastal aerial surveys in 2006–2008 (1.27; Thomas *et al.* 2009). Correction factors f(0) = 2.49 (Forney and Barlow 1998) and g(0) = 0.30 (Forney and Barlow 1998; Mallonee 1991) were also used in the density calculation. Since the group size used in the average density estimate was relatively high compared to other data sources and the CV was near to one, an inflation factor of 2 was used to estimate the maximum densities from average densities in both habitat types. Gray whales are not commonly associated with sea ice, but may occur close to sea ice, so the densities for open-water habitat were also used for ice-margin habitat. Densities from vessel based surveys in the Chukchi Sea during non-seismic periods and locations in July–August of 2006–2008 (Haley *et al.* 2009b) ranged from 0.0009/km^2 to 0.0034/km^2 with a maximum 95 percent CI of 0.0146 km^2. This suggests that the densities used in the calculations and shown in Table 1 are somewhat higher than are expected to be observed from vessels near the area of planned operations.

Gray whale densities are expected to be much higher in the summer months than during the fall when most whales start their southbound migration. Moore *et al.* (2000b) found that the distribution of gray whales was more widely dispersed through the northern Chukchi Sea and limited to nearshore areas where most whales were observed in water less than 115 ft (35 m) deep. With similar amounts of on-transect effort between summer and fall aerial surveys in 2008–2009, gray whale sightings were three times higher in July–August than in September–October, and five times higher taking into account all effort and sightings (COMIDA 2009). Thomas *et al.* (2009) also reported decreased sighting rates of gray whales in the fall.

The on-transect effort and associated gray whale sightings (27 sightings during 44,352 km of on-transect effort) in water depth of 118–164 ft (36–50 m) during autumn (Moore *et al.* 2000b; 12) was used as the average density estimate for the Chukchi Sea during the fall period. A group size value of 2.49 (CV=1.37) calculated from the BWASP database was used in the density calculation, along with the same f(0) and g(0) values described above. The group size value of 2.49 was again higher than the average group size calculated from preliminary COMIDA data (1.24; COMIDA 2009) and as reported from coastal aerial surveys in 2006–2008 (1.12; Thomas *et al.* 2009). Densities from vessel based surveys in the Chukchi Sea during non-seismic periods and locations in September–October of 2006–2008 (Haley *et al.* 2009b) ranged from 0.0011/km^2 to 0.0024/km^2 with a maximum 95 percent CI of 0.0183 km^2. This suggests the densities used in the calculations and shown in Table 2 are somewhat higher than are likely to be observed from vessels near the area of planned operations.

Harbor Porpoise—Harbor Porpoise densities were estimated from industry data collected during 2006–2008 activities in the Chukchi Sea. Prior to 2006, no reliable estimates were available for the Chukchi Sea and harbor porpoise presence was expected to be very low and limited to nearshore regions. For this reason, the data collected from industry vessels was considered to be the best available data. Observers on industry vessels in 2006–2008, however, recorded sightings throughout the Chukchi Sea during the summer and early fall months. Density estimates from 2006–2008 observations during non-seismic periods and locations in July–August ranged from 0.0009/km^2 to 0.0016/km^2 with a maximum 95 percent CI of 0.0016/km^2 (Haley *et al.* 2009b). The median value from the summer season of those three years (0.0011/km^2) was used as the average open-water density estimate while the high value (0.0016/km^2) was used as the maximum estimate (Table 1). Harbor porpoise are not expected to be present in higher numbers near ice, so the open-water densities were used for ice-margin habitat in both seasons. Harbor porpoise densities recorded during industry operations in the fall months of 2006–2008 were slightly lower and ranged from 0.0002/km^2 to 0.0013/km^2 with a maximum 95 percent CI of 0.0044/km^2. The median value (0.0010/km^2) was again used as the average density estimate and the high value (0.0013/km^2) was used as the maximum estimate (Table 2).

Other Cetaceans—The remaining four cetacean species that could be encountered in the Chukchi Sea during Statoil's planned seismic survey include the humpback whale, killer whale, minke whale, and fin whale. Although there is evidence of the occasional occurrence of these animals in the Chukchi Sea, it is unlikely that more than a few individuals will be encountered during the proposed activities. George and Suydam (1998) reported killer whales, Brueggeman *et al.* (1990) and Haley *et al.* (2009b) reported minke whale, and COMIDA (2009) and Haley *et al.* (2009b) reported fin whales off of Ledyard Bay in the Chukchi Sea.

(2) Pinnipeds

Four species of pinnipeds may be encountered in the Chukchi Sea: Ringed seal, bearded seal, spotted seal, and ribbon seal. Each of these species, except the spotted seal, is associated with both the ice margin and the nearshore area. The ice margin is considered preferred habitat (as compared to the nearshore areas) during most seasons.

Ringed and Bearded Seals—Ringed seal and bearded seal average summer ice-margin densities (Table 1) were available in Bengtson *et al.* (2005) from spring surveys in the offshore pack ice zone (zone 12P) of the northern Chukchi Sea. However, corrections for bearded seal availability, g(0), based on haulout and diving patterns were not available. Densities of ringed and bearded seals in open water are expected to be somewhat lower in the summer when preferred pack ice habitat may still be present in the Chukchi Sea. Average and maximum open-water densities have been estimated as ¾ of the ice margin densities during the summer for both species. The fall density of ringed seals in the offshore Chukchi Sea has been estimated as ⅔ the summer densities because ringed seals begin to reoccupy nearshore fast ice areas as it forms in the fall. Bearded seals may begin to leave the Chukchi Sea in the fall, but less is known about their movement patterns so fall densities were left unchanged from summer densities. For comparison, the ringed seal density estimates calculated from data collected during summer 2006–2008 industry operations ranged from 0.0082/km^2 to 0.0221/km^2 with a maximum 95 percent CI of 0.0577/km^2 (Haley *et al.* 2009b). These estimates are lower than those made by Bengtson *et al.* (2005) which is not surprising given the different survey methods and timing.

Spotted Seal—Little information on spotted seal densities in offshore areas of the Chukchi Sea is available. Spotted seals are often considered to be predominantly a coastal species except in the spring when they may be found in the southern margin of the retreating sea ice, before they move to shore. However, satellite tagging has shown that they sometimes undertake long excursions into offshore waters during summer (Lowry *et al.* 1994, 1998). Spotted seal densities in the summer were estimated by multiplying the ringed seal densities by 0.02. This was based on the ratio of the estimated Chukchi populations of the two species. Chukchi Sea spotted seal abundance was estimated by assuming that 8% of the Alaskan population of spotted seals is present in the Chukchi Sea during the summer and fall (Rugh *et al.* 1997), the Alaskan population of spotted seals is 59,214 (Angliss and Allen 2009), and that the population of ringed seals in the Alaskan Chukchi Sea is >208,000 animals (Bengtson *et al.* 2005). In the fall, spotted seals show increased use of coastal haulouts so densities were estimated to be ⅔ of the summer densities.

Ribbon Seal—Ribbon seals have been reported in very small numbers within the Chukchi Sea by observers on industry vessels (two sightings; Haley *et al.* 2009b). The resulting density estimate of 0.0003/km^2 was used as the average density and a multiplier of 4 was used as the estimated maximum density for both seasons and habitat zones.

Potential Number of Takes by Harassment

This subsection provides estimates of the number of individuals potentially exposed to sound levels ≥160 dB re 1 μPa (rms). The estimates are based on a consideration of the number of marine mammals that might be disturbed (through Level B harassment) by operations in the Chukchi Sea and the anticipated area exposed to sound levels of 160 dB re 1 μPa (rms).

As described above, marine mammal density estimates for the Chukchi Sea have been derived for two time periods, the summer period (July–August), and the fall period (September–October). Animal densities encountered in the Chukchi Sea during both of these time periods will further depend on the habitat zone within which the source vessel is operating, *i.e.,* open water or ice margin. The seismic source vessel is not an icebreaker and cannot tow survey equipment through pack ice. Under this assumption, densities of marine mammals expected to be observed near ice margin areas have been applied to 10% of the proposed 3D survey area and 2D tracklines in both seasons. Densities of marine mammals expected to occur in open water areas have been applied to the remaining 90% of the 3D survey and 2D tracklines area in both seasons.

The number of individuals of each species potentially exposed to received levels ≥160 dB re 1 μPa (rms) within each season and habitat zone was estimated by multiplying

- The anticipated area to be ensonified to the specified level in each season and habitat zone to which that density applies, by
- The expected species density.

The numbers of individuals potentially exposed were then summed for each species across the two seasons and habitat zones. Some of the animals estimated to be exposed, particularly migrating bowhead whales, might show avoidance reactions before being exposed to ≥160 dB re 1 μPa (rms). Thus, these calculations actually estimate the number of individuals potentially exposed to ≥160 dB that would occur if there were no avoidance of the area ensonified to that level.

(1) 3D Seismic Survey Area

The size of the proposed 3D seismic survey area is 915 mi^2 (2,370 km^2) and located >100 mi (160 km) offshore. Approximately ¼ of the area (~234 mi^2, or ~606 km^2) is expected to be surveyed in August (weather depending). This area, with a 160 dB radius of 8 mi (13 km) along each point of its perimeter equals a total area of ~1,081 mi^2 (~2,799 km^2). Summer marine mammal densities from Table 1 have been applied to this area. The other ¾ of the survey area (~687 mi^2, or ~1,779 km^2) is expected to be covered in September–October. This area, also with a 160 dB radius of 8 mi (13 km) along each point of its perimeter results in a total area of ~1,813 mi^2 (~4,695 km^2). Fall marine mammal densities from Table 2 have been applied to this area. Based on these assumptions and those described above, the estimates of marine mammals potentially exposed to sounds ≥160 dB in the Chukchi Sea from seismic data acquisition in the 3D survey area were calculated in Table 3.

For the common species, the requested numbers were calculated as described above and based on the average and maximum densities reported. For less common species, for which minimum density estimates were assumed, the numbers were set to a minimum to allow for chance encounters. The mitigation gun (60 in^3) will be active during turns extending about 1.6 mi (2.5 km) outside the 3D survey area. The estimated 160 dB radius for the 60 in^3 mitigation gun is 5,906 ft (1,800 m) and therefore falls well within the area expected to be exposed to received sound levels of ≥160 dB of the 3D survey area.

TABLE 3—SUMMARY OF THE NUMBER OF POTENTIAL EXPOSURES OF MARINE MAMMALS TO RECEIVED SOUND LEVELS IN THE WATER OF ≥160 DB DURING STATOIL'S PLANNED MARINE SEISMIC SURVEY IN THE CHUKCHI SEA, ALASKA, 2010

Species	Number of exposure to sound levels > 160 dB re 1 μPa (rms) by 3D seismic survey	Number of exposure to sound levels > 160 dB re 1 μPa (rms) by 2D seismic survey	Total number of exposure to sound levels > 160 dB re 1 μPa (rms)
Beluga whale	97	87	184
Killer whale	1	1	2
Harbor porpoise	8	13	21
Bowhead whale	95	63	158
Gray whale	52	92	144
Humpback whale	1	1	2
Fin whale	1	1	2
Minke whale	1	1	2
Bearded seal	82	132	214
Ribbon seal	2	4	6
Ringed seal	2,253	4,234	6,487
Spotted seal	45	85	130

(2) 2D Seismic Survey Lines

Seismic data along the ~420 mi (675 km) of four 2D survey tracklines might be acquired with the full airgun array if access to the 3D survey area is restricted (*e.g.,* ice conditions), or 3D acquisition progress is better than anticipated. Under the assumption that these restrictive weather conditions will mainly be an issue in the early summer season, 80% of the 2D tracklines are assumed to be acquired during August and 20% during the fall. The total area potentially exposed to ≥160 dB from these tracklines was calculated with the trackline sections outside the 3D survey area. Excluding these sections results in a total trackline length of ~285 mi (460 km). With a 160 dB radius of ~8 mi (13 km) this results in a total exposed area of ~7,432 mi^2 (11,960 km^2). Such summer densities were used for 80% of the total area (5,945 mi^2, or 9,568 km^2) and fall densities for the remaining 20% (1,486 mi^2, or 2,392 km^2). Following a similar approach as for the 3D survey area, numbers of more common marine mammal species were calculated based on the average and maximum densities and for less common species the numbers were set to a minimum to allow for chance encounters. The results of estimates of marine mammals potentially exposed to sounds ≥160 dB in the Chukchi Sea from seismic data acquisition along the 2D tracklines are presented in Table 3.

Estimated Take Conclusions

Cetaceans—Effects on cetaceans are generally expected to be restricted to avoidance of an area around the seismic survey and short-term changes in behavior, falling within the MMPA definition of "Level B harassment".

Using the 160 dB criterion, the average estimates of the numbers of individual cetaceans exposed to sounds ≥160 dB re 1 μPa (rms) represent varying proportions of the populations of each species in the Beaufort Sea and adjacent waters. For species listed as "Endangered" under the ESA, the estimates include approximately 158 bowheads. This number is approximately 1.11% of the Bering-Chukchi-Beaufort population of >14,247 assuming 3.4% annual population growth from the 2001 estimate of >10,545 animals (Zeh and Punt 2005). For other cetaceans that might occur in the vicinity of the marine seismic survey in the Chukchi Sea, they also represent a very small proportion of their respective populations. The average estimates of the number of belugas, killer whales, harbor porpoises, gray whales, fin whales, humpback whales, and minke whales that might be exposed to ≥160 dB re 1 μPa (rms) are 183, 2, 21, 144, 2, 2, and 2. These numbers represent 4.95%, 0.62%, 0.04%, 0.81%, 0.03%, 0.21%, and 0.19% of these species respective populations in the proposed action area.

Seals—A few seal species are likely to be encountered in the study area, but ringed seal is by far the most abundant in this area. The average estimates of the numbers of individuals exposed to sounds at received levels ≥160 dB re 1 μPa (rms) during the proposed seismic survey are as follows: Ringed seals (6,487), bearded seals (215), spotted seals (129), and ribbon seals (6). These numbers represent 2.81%, 0.09%, 0.22%, and 0.01% of Alaska stocks of ringed, bearded, spotted, and ribbon seals.

Impact on Availability of Affected Species or Stock for Taking for Subsistence Uses

Relevant Subsistence Uses

The disturbance and potential displacement of marine mammals by sounds from the proposed marine surveys are the principal concerns related to subsistence use of the area. Subsistence remains the basis for Alaska Native culture and community. Marine mammals are legally hunted in Alaskan waters by coastal Alaska Natives. In rural Alaska, subsistence activities are often central to many aspects of human existence, including patterns of family life, artistic expression, and community religious and celebratory activities. Additionally, the animals taken for subsistence provide a significant portion of the food that will last the community throughout the year. The main species that are hunted include bowhead and beluga whales, ringed, spotted, and bearded seals, walruses, and polar bears. (Both the walrus and the polar bear are under the USFWS' jurisdiction.) The importance of each of these species varies among the communities and is largely based on availability.

Subsistence hunting and fishing continue to be prominent in the household economies and social welfare of some Alaskan residents, particularly among those living in small, rural villages (Wolfe and Walker 1987). Subsistence remains the basis for Alaska Native culture and community. In rural Alaska, subsistence activities are often central to many aspects of human existence, including patterns of family life, artistic expression, and community religious and celebratory activities.

Marine mammals are legally hunted in Alaskan waters by coastal Alaska Natives; species hunted include

bowhead and beluga whales; ringed, spotted, and bearded seals; walruses, and polar bears. The importance of each of the various species varies among the communities based largely on availability. Bowhead whales, belugas, and walruses are the marine mammal species primarily harvested during the time of the proposed seismic survey. There is little or no bowhead hunting by the community of Point Lay, so beluga and walrus hunting are of more importance there. Members of the Wainwright community hunt bowhead whales in the spring, although bowhead whale hunting conditions there are often more difficult than elsewhere, and they do not hunt bowheads during seasons when Statoil's seismic operation would occur. Depending on the level of success during the spring bowhead hunt, Wainwright residents may be very dependent on the presence of belugas in a nearby lagoon system during July and August. Barrow residents focus hunting efforts on bowhead whales during the spring and generally do not hunt beluga then. However, Barrow residents also hunt in the fall, when Statoil expects to be conducting seismic surveys (though not near Barrow).

(1) Bowhead Whales

Bowhead whale hunting is a key activity in the subsistence economies of northwest Arctic communities. The whale harvests have a great influence on social relations by strengthening the sense of Inupiat culture and heritage in addition to reinforcing family and community ties.

An overall quota system for the hunting of bowhead whales was established by the International Whaling Commission (IWC) in 1977. The quota is now regulated through an agreement between NMFS and the Alaska Eskimo Whaling Commission (AEWC). The AEWC allots the number of bowhead whales that each whaling community may harvest annually (USDI/BLM 2005). The annual take of bowhead whales has varied due to (a) changes in the allowable quota level and (b) year-to-year variability in ice and weather conditions, which strongly influence the success of the hunt.

Bowhead whales migrate around northern Alaska twice each year, during the spring and autumn, and are hunted in both seasons. Bowhead whales are hunted from Barrow during the spring and the fall migration and animals are not successfully harvested every year. The spring hunt along Chukchi villages and at Barrow occurs after leads open due to the deterioration of pack ice; the spring hunt typically occurs from early April until the first week of June. The fall migration of bowhead whales that summer in the eastern Beaufort Sea typically begins in late August or September. Fall migration into Alaskan waters is primarily during September and October.

In the fall, subsistence hunters use aluminum or fiberglass boats with outboards. Hunters prefer to take bowheads close to shore to avoid a long tow during which the meat can spoil, but Braund and Moorehead (1995) report that crews may (rarely) pursue whales as far as 50 mi (80 km). The autumn bowhead hunt usually begins in Barrow in mid-September, and mainly occurs in the waters east and northeast of Point Barrow.

The scheduling of this seismic survey has been discussed with representatives of those concerned with the subsistence bowhead hunt, most notably the AEWC, the Barrow Whaling Captains' Association, and the North Slope Borough (NSB) Department of Wildlife Management.

The planned mobilization and start date for seismic surveys in the Chukchi Sea (~20 July and ~1 August) is well after the end of the spring bowhead migration and hunt at Wainwright and Barrow. Seismic operations will be conducted far offshore from Barrow and are not expected to conflict with subsistence hunting activities. Specific concerns of the Barrow whaling captains are addressed as part of the Plan of Cooperation with the AEWC (*see* below).

(2) Beluga Whales

Beluga whales are available to subsistence hunters along the coast of Alaska in the spring when pack-ice conditions deteriorate and leads open up. Belugas may remain in coastal areas or lagoons through June and sometimes into July and August. The community of Point Lay is heavily dependent on the hunting of belugas in Kasegaluk Lagoon for subsistence meat. From 1983–1992 the average annual harvest was ~40 whales (Fuller and George 1997). In Wainwright and Barrow, hunters usually wait until after the spring bowhead whale hunt is finished before turning their attention to hunting belugas. The average annual harvest of beluga whales taken by Barrow for 1962–1982 was five (MMS 1996). The Alaska Beluga Whale Committee recorded that 23 beluga whales had been harvested by Barrow hunters from 1987 to 2002, ranging from 0 in 1987, 1988 and 1995 to the high of 8 in 1997 (Fuller and George 1997; Alaska Beluga Whale Committee 2002 in USDI/BLM 2005). The seismic survey activities take place well offshore, far away from areas that are used for beluga hunting by the Chukchi Sea communities. It is possible, but unlikely, that accessibility to belugas during the subsistence hunt could be impaired during the survey.

(3) Ringed Seals

Ringed seals are hunted mainly from October through June. Hunting for these smaller mammals is concentrated during winter because bowhead whales, bearded seals and caribou are available through other seasons. In winter, leads and cracks in the ice off points of land and along the barrier islands are used for hunting ringed seals. The average annual ringed seal harvest was 49 seals in Point Lay, 86 in Wainwright, and 394 in Barrow (Braund *et al.* 1993; USDI/BLM 2003, 2005). Although ringed seals are available year-round, the seismic survey will not occur during the primary period when these seals are typically harvested. Also, the seismic survey will be largely in offshore waters where the activities will not influence ringed seals in the nearshore areas where they are hunted.

(4) Spotted Seals

The spotted seal subsistence hunt peaks in July and August along the shore where the seals haul out, but usually involves relatively few animals. Spotted seals typically migrate south by October to overwinter in the Bering Sea. During the fall migration spotted seals are hunted by the Wainright and Point Lay communities as the seals move south along the coast (USDI/BLM 2003). Spotted seals are also occasionally hunted in the area off Point Barrow and along the barrier islands of Elson Lagoon to the east (USDI/BLM 2005). The seismic survey will remain offshore of the coastal harvest area of these seals and should not conflict with harvest activities.

(5) Bearded Seals

Bearded seals, although generally not favored for their meat, are important to subsistence activities in Barrow and Wainright, because of their skins. Six to nine bearded seal hides are used by whalers to cover each of the skin-covered boats traditionally used for spring whaling. Because of their valuable hides and large size, bearded seals are specifically sought. Bearded seals are harvested during the spring and summer months in the Chukchi Sea (USDI/BLM 2003, 2005). The animals inhabit the environment around the ice floes in the drifting nearshore ice pack, so hunting usually occurs from boats in the drift ice. Most bearded seals are harvested in coastal areas inshore of the

proposed survey so no conflicts with the harvest of bearded seals are expected.

In the event that both marine mammals and hunters are near the 3D survey area when seismic surveys are in progress, the proposed project potentially could impact the availability of marine mammals for harvest in a small area immediately around the vessel, in the case of pinnipeds, and possibly in a large area in the case of migrating bowheads. However, the majority of marine mammals are taken by hunters within ~21 mi (~33 km) from shore (Figure 2 in Statoil's IHA application), and the seismic source vessel M/V Geo Celtic will remain far offshore, well outside the hunting areas. Considering the timing and location of the proposed seismic survey activities, as described earlier in the document, the proposed project is not expected to have any significant impacts to the availability of marine mammals for subsistence harvest. Specific concerns of the respective communities are addressed as part of the Plan of Cooperation between Statoil and the AEWC.

Potential Impacts to Subsistence Uses

NMFS has defined "unmitigable adverse impact" in 50 CFR 216.103 as:

> * * * an impact resulting from the specified activity: (1) That is likely to reduce the availability of the species to a level insufficient for a harvest to meet subsistence needs by: (i) Causing the marine mammals to abandon or avoid hunting areas; (ii) Directly displacing subsistence users; or (iii) Placing physical barriers between the marine mammals and the subsistence hunters; and (2) That cannot be sufficiently mitigated by other measures to increase the availability of marine mammals to allow subsistence needs to be met.

Noise and general activity during Statoil's proposed open water marine seismic survey have the potential to impact marine mammals hunted by Native Alaskans. In the case of cetaceans, the most common reaction to anthropogenic sounds (as noted previously in this document) is avoidance of the ensonified area. In the case of bowhead whales, this often means that the animals divert from their normal migratory path by several kilometers. Additionally, general vessel presence in the vicinity of traditional hunting areas could negatively impact a hunt.

In the case of subsistence hunts for bowhead whales in the Chukchi Sea, there could be an adverse impact on the hunt if the whales were deflected seaward (further from shore) in traditional hunting areas. The impact would be that whaling crews would have to travel greater distances to intercept westward migrating whales, thereby creating a safety hazard for whaling crews and/or limiting chances of successfully striking and landing bowheads.

Plan of Cooperation (POC or Plan)

Regulations at 50 CFR 216.104(a)(12) require IHA applicants for activities that take place in Arctic waters to provide a POC or information that identifies what measures have been taken and/or will be taken to minimize adverse effects on the availability of marine mammals for subsistence purposes.

Statoil states that it intends to maintain an open and transparent process with all stakeholders throughout the life-cycle of activities in the Chukchi Sea. Statoil began the stakeholder engagement process in 2009 with meeting Chukchi Sea community leaders at the tribal, city, and corporate level. Statoil will continue to engage with leaders, community members, and subsistence groups, as well as local, state, and federal regulatory agencies throughout the exploration and development process.

As part of stakeholder engagement, Statoil has conducted Plan of Cooperation (POC) meetings for its seismic operations in the Chukchi Sea in the communities and villages of Barrow, Wainwright, Point Lay, and Point Hope, and met with representatives of the Marine Mammal Co-Management groups, including the AEWC, Ice Seal Commission, Alaska Beluga Whale Committee, Alaska Eskimo Walrus Commission, and the Nanuq Commission, on March 22, 2010. At each of these meetings, Statoil described the proposed survey program and measures it plans to take, or has taken, to minimize adverse effects its seismic survey may have on the availability of marine mammals for subsistence use. Statoil requested comments and feedback from subsistence users, and incorporated those comments and concerns in the final version of the POC, which was released on May 28, 2010. The final POC document contains the following information: (1) A description of the proposed marine seismic survey; (2) documentation of consultation with local communities and tribal governments; (3) a description of mitigation measures to reduce the impact of Statoil's planned activity on subsistence; (4) ongoing Chukchi Sea scientific research which Statoil is conducting to gather information on the marine environment; and (5) the future plans for meetings and communication with the affected subsistence Chukchi Sea communities.

In addition, Statoil has entered into a Communication Protocol through a Participation Agreement with Shell to fund and staff a communications station out of Wainwright. The communications center will be staffed by Inupiat operators and on a 24/7 basis during the 2010 subsistence bowhead whale hunt. Call center staff will receive notifications from vessels at least once every six hours and will plot the probable location of vessels on a map at the communications center. Communications center staff will apprise vessel operators of potential operations that may conflict with subsistence whaling activities.

In addition, under the POC, at least five observers will be based aboard the seismic source vessel and at least three MMOs on the chase/monitoring vessels when there are 24 hours of daylight, decreasing as the hours of daylight decrease. Primary roles for MMOs are defined as monitoring for the presence of marine mammals during all daylight airgun operations and during any nighttime ramp-up of the airguns. The MP provides additional detail on the number of MMOs, crew rotations, and observer qualification and training requirements, as well as monitoring methodology, including protocols for poor visibility and night monitoring, use of specialized field equipment, field data-recording, verification, handling, and security, and field reporting. Lastly, the Participation Agreement provides that Statoil (and Shell) will fund a 24/7 communications center staffed by Inupiat personnel. The center will have contact with all vessels at least once every hour.

Following the 2010 season, Statoil intends to have a post-season co-management meeting with the commissioners and committee heads to discuss results of mitigation measures and outcomes of the preceding season. The goal of the post-season meeting is to build upon the knowledge base, discuss successful or unsuccessful outcomes of mitigation measures, and possibly refine plans or mitigation measures if necessary.

Mitigation Measures

In order to issue an incidental take authorization under Section 101(a)(5)(D) of the MMPA, NMFS must set forth the permissible methods of taking pursuant to such activity, and other means of effecting the least practicable adverse impact on such species or stock and its habitat, paying particular attention to rookeries, mating grounds, and areas of similar significance, and on the

availability of such species or stock for taking for certain subsistence uses.

For the Statoil open water marine seismic survey in the Chukchi Sea, Statoil worked with NMFS and proposed the following mitigation measures to minimize the potential impacts to marine mammals in the project vicinity as a result of the marine seismic survey activities.

As part of the application, Statoil submitted to NMFS a Marine Mammal Monitoring and Mitigation Program (4MP) for its open water seismic survey in the Chukchi Sea during the 2010 open-water season. The objectives of the 4MP are:

- To ensure that disturbance to marine mammals and subsistence hunts is minimized and all permit stipulations are followed,
- To document the effects of the proposed survey activities on marine mammals, and
- To collect baseline data on the occurrence and distribution of marine mammals in the study area.

For Statoil's 2010 open water marine seismic surveys in the Chukchi Sea, the following mitigation measures are required.

(1) Sound Source Measurements

As described above, previous measurements of similar airgun arrays in the Chukchi Sea were used to model the distances at which received levels are likely to fall below 120, 160, 180, and 190 dB re 1 μPa (rms) from the planned airgun sources. These modeled distances will be used as temporary safety radii until measurements of the airgun sound source are conducted. The measurements will be made at the beginning of the field season and the measured radii used for the remainder of the survey period.

The objectives of the sound source verification measurements planned for 2010 in the Chukchi Sea will be to measure the distances in the broadside and endfire directions at which broadband received levels reach 190, 180, 170, 160, and 120 dB re 1 μPa (rms) for the energy source array combinations that may be used during the survey activities. The configurations will include at least the full array and the operation of a single mitigation source that will be used during power downs. The measurements of energy source array sounds will be made by an acoustics contractor at the beginning of the survey and the distances to the various radii will be reported as soon as possible after recovery of the equipment. The primary radii of concern will be the 190 and 180 dB safety radii for pinnipeds and cetaceans, respectively, and the 160 dB radii for zone of influence (ZOI). In addition to reporting the radii of specific regulatory concern, nominal distances to other sound isopleths down to 120 dB (rms) will be reported in increments of 10 dB.

Data will be previewed in the field immediately after download from the ocean bottom hydrophone (OBH) instruments. An initial sound source analysis will be supplied to NMFS and the airgun operators within 120 hours of completion of the measurements, if possible. The report will indicate the distances to sound levels between 190 dB re 1 μPa (rms) and 120 dB re 1 μPa (rms) based on fits of empirical transmission loss formulae to data in the endfire and broadside directions. The 120-hour report findings will be based on analysis of measurements from at least three of the OBH systems. A more detailed report including analysis of data from all OBH systems will be issued to NMFS as part of the 90-day report following completion of the acoustic program.

(2) Safety and Disturbance Zones

Under current NMFS guidelines, "safety radii" for marine mammal exposure to impulse sources are customarily defined as the distances within which received sound levels are ≥180 dB re 1 μPa (rms) for cetaceans and ≥190 dB re 1 μPa (rms) for pinnipeds. These safety criteria are based on an assumption that SPL received at levels lower than these will not injure these animals or impair their hearing abilities, but that SPL received at higher levels might have some such effects. Disturbance or behavioral effects to marine mammals from underwater sound may occur after exposure to sound at distances greater than the safety radii (Richardson *et al.* 1995).

Initial safety and disturbance radii for the sound levels produced by the survey activities have been estimated from measurements of similar seismic arrays used in the Chukchi Sea in previous years. These radii will be used for mitigation purposes until results of direct measurements are available early during the exploration activities.

The basis for the estimation of distances to the four received sound levels from the proposed 3000 in^3 airgun array operating at a depth of 20 ft (6 m) are the 2006, 2007 and 2008 sound source verification (SSV) measurements in the Chukchi Sea of a similar array, towed at a similar depth. The measured airgun array had a total discharge volume of 3,147 in^3 and was composed of three identically-tuned Bolt airgun sub-arrays, totaling 24 airguns (6 clusters of 2 airguns and 12 single airguns). The proposed 3,000 in^3 array is also composed of three strings with a total of 26 active airguns in 13 clusters. The difference in discharge volume would lead to an expected loss of less than 0.2 dB and is neglected in this assessment. The estimated source level for the full 3,000 in^3 array is 245 dB re 1 μPA (rms). Without measurement data for the specific site to be surveyed, it is reasonable to adopt the maximum distances obtained from a similar array during previous measurements in the Chukchi Sea. Table 1 summarizes the distances to received levels of 190, 180 160, and 120 dB re 1 μPa (rms) that are adopted for the analysis for the proposed survey. Distances for received levels of 120 dB are highly variable, in part because the bottom geoacoustic properties will have a major effect on received levels at such distances.

To estimate the distances to various received levels from the 60 in^3 mitigation gun the data from previous measurements of a 30 in^3 gun were used. In general the pressure increase relative to a 30 in^3 gun can be derived by calculating the square root of (60/30), which is 1.41. This means that the dB levels for the sound pressure levels of a 60 in^3 will increase by approximately 3 dB (20Log[1.41]) compared to the 30 in^3 gun. The distances as summarized in Table 1 were derived by adding 3 dB to the constant term of the equation RL = 226.6–21.2log(R)–0.00022R. The estimated source level of this single 60 in^3 airgun is 230 dB re 1 μPa (rms).

TABLE 1—ESTIMATED DISTANCES TO RECEIVED SOUND LEVELS ≥190, 180, 170, 160, AND 120 dB re 1 μPA (rms) FROM THE 3,000 IN^3 AIRGUN ARRAY AND THE 60 IN^3 MITIGATION GUN OF THE PROPOSED SEISMIC SURVEY. THESE DISTANCES ARE BASED ON MEASUREMENTS IN THE CHUKCHI SEA FROM A SIMILAR AIRGUN ARRAY.

Received Levels (dB re 1 μPa rms)	Distance (m)	
	3,000 in^3	60 in^3
	(full airgun array)	(mitigation airgun)
190	700	70
180	2,500	220
160	13,000	1,800
120	70,000–120,000	50,000

An acoustics contractor will perform the direct measurements of the received levels of underwater sound versus distance and direction from the energy source arrays using calibrated hydrophones. The acoustic data will be analyzed as quickly as reasonably practicable in the field and used to verify (and if necessary adjust) the safety distances. The field report will be made available to NMFS and the MMOs within 120 hrs of completing the measurements. The mitigation measures to be implemented at the 190 and 180 dB sound levels will include power downs and shut downs as described below.

(3) Power Downs and Shut Downs

A power-down is the immediate reduction in the number of operating energy sources from all firing to some smaller number. A shutdown is the immediate cessation of firing of all energy sources. The arrays will be immediately powered down whenever a marine mammal is sighted approaching close to or within the applicable safety zone of the full arrays but is outside or about to enter the applicable safety zone of the single mitigation source. If a marine mammal is sighted within the applicable safety zone of the single mitigation airgun, the entire array will be shut down (*i.e.,* no sources firing).

Following a power-down or shutdown, operation of the airgun array will not resume until the marine mammal has cleared the applicable safety zone. The animal will be considered to have cleared the safety zone if it:

- Is visually observed to have left the safety zone;
- Has not been seen within the zone for 15 min in the case of small odontocetes and pinnipeds; or
- Has not been seen within the zone for 30 min in the case of mysticetes.

In the unanticipated event that an injured or dead marine mammal is sighted within an area where the holder of this Authorization deployed and utilized seismic airguns within the past 24 hours, immediately shutdown the seismic airgun array and notify the Marine Mammal Stranding Network within 24 hours of the sighting (telephone: 1–800–853–1964).

In the event that the marine mammal has been determined to have been deceased for at least 72 hours, as certified by the lead MMO onboard the source vessel, and no other marine mammals have been reported injured or dead during that same 72 hour period, the airgun array may be restarted by conducting the necessary ramp-up procedures described below upon completion of a written certification by the MMO. The certification must include the following: Species or description of the animal(s); the condition of the animal(s) (including carcass condition if the animal is dead); location and time of first discovery; observed behaviors (if alive); and photographs or video (if available). Within 24 hours after the event, Statoil must notify the designated staff person by telephone or email of the event and ensure that the written certification is provided to the NMFS staff person.

In the event that the marine mammal injury resulted from something other than seismic airgun operations (*e.g.,* gunshot wound, polar bear attack), as certified by the lead MMO onboard the seismic vessel, the airgun array may be restarted by conducting the necessary ramp-up procedures described below upon completion of a written certification by the MMO. The certification must include the following: Species or description of the animal(s); the condition of the animal(s) (including carcass condition if the animal is dead); location and time of first discovery; observed behaviors (if alive); and photographs or video (if available). Within 24 hours after the event, Statoil must notify the designated staff person by telephone or email of the event and ensure that the written certification is provided to the NMFS staff person.

(4) Ramp Ups

A ramp up of an airgun array provides a gradual increase in sound levels, and involves a stepwise increase in the number and total volume of airguns firing until the full volume is achieved.

The purpose of a ramp up (or "soft start") is to "warn" cetaceans and pinnipeds in the vicinity of the airguns and to provide time for them to leave the area and thus avoid any potential injury or impairment of their hearing abilities.

During the proposed seismic survey, the seismic operator will ramp up the airgun arrays slowly. Full ramp ups (*i.e.,* from a cold start after a shut down, when no airguns have been firing) will begin by firing a single airgun in the array. The minimum duration of a shut-down period, *i.e.,* without air guns firing, which must be followed by a ramp up, is typically the amount of time it would take the source vessel to cover the 180-dB safety radius. The actual time period depends on ship speed and the size of the 180-dB safety radius. That period is estimated to be about 15–20 minutes based on the modeling results described above and a survey speed of 4 knots.

A full ramp up, after a shut down, will not begin until there has been a minimum of 30 min of observation of the safety zone by MMOs to assure that no marine mammals are present. The entire safety zone must be visible during the 30-minute lead-in to a full ramp up. If the entire safety zone is not visible, then ramp up from a cold start cannot begin. If a marine mammal(s) is sighted within the safety zone during the 30-minute watch prior to ramp up, ramp up will be delayed until the marine mammal(s) is sighted outside of the safety zone or the animal(s) is not sighted for at least 15–30 minutes: 15 minutes for small odontocetes and pinnipeds, or 30 minutes for baleen whales and large odontocetes.

During turns and transit between seismic transects, at least one airgun will remain operational. The ramp-up procedure still will be followed when

increasing the source levels from one airgun to the full arrays. However, keeping one airgun firing will avoid the prohibition of a cold start during darkness or other periods of poor visibility. Through use of this approach, seismic operations can resume upon entry to a new transect without a full ramp up and the associated 30-minute lead-in observations. MMOs will be on duty whenever the airguns are firing during daylight, and during the 30-min periods prior to ramp-ups as well as during ramp-ups. Daylight will occur for 24 h/day until mid-August, so until that date MMOs will automatically be observing during the 30-minute period preceding a ramp up. Later in the season, MMOs will be called out at night to observe prior to and during any ramp up. The seismic operator and MMOs will maintain records of the times when ramp-ups start, and when the airgun arrays reach full power.

(5) Mitigation Measures Concerning Baleen Whale Aggregations

A 160-dB vessel monitoring zone for large whales will be established and monitored in the Chukchi Sea during all seismic surveys. Whenever an aggregation of bowhead whales or gray whales (12 or more whales of any age/sex class that appear to be engaged in a nonmigratory, significant biological behavior (*e.g.,* feeding, socializing)) are observed during an aerial or vessel monitoring program within the 160-dB safety zone around the seismic activity, the seismic operation will not commence or will shut down, until two consecutive surveys (aerial or vessel) indicate they are no longer present within the 160-dB safety zone of seismic-surveying operations.

Survey information, especially information about bowhead whale cow/calf pairs or feeding bowhead or gray whales, shall be provided to NMFS as required in MMPA authorizations, and will form the basis for NMFS determining whether additional mitigation measures, if any, will be required over a given time period.

(6) Mitigation Measures Concerning Vessel Speed and Directions

Furthermore, the following measures concerning vessel speed and directions are required for Statoil's 2010 open water marine seismic surveys in the Chukchi Sea:

(1) All vessels should reduce speed when within 300 yards (274 m) of whales, and those vessels capable of steering around such groups should do so. Vessels may not be operated in such a way as to separate members of a group of whales from other members of the group;

(2) Avoid multiple changes in direction and speed when within 300 yards (274 m) of whales; and

(3) When weather conditions require, such as when visibility drops, support vessels must adjust speed accordingly to avoid the likelihood of injury to whales.

(7) Subsistence Mitigation Measures

The following measures, plans, and programs will be implemented by Statoil during its 2010 open water marine seismic survey in the Chukchi Sea to monitor and mitigate potential impacts to subsistence users and resources. These measures, plans, and programs have been effective in past seasons of work in the Arctic and were developed in past consultations with potentially affected communities.

Statoil will not be entering the Chukchi Sea until early August, so there will be no potential conflict with spring bowhead whale or beluga subsistence whaling in the polynya zone. Statoil's seismic survey area is ~100 mi (~161 km) northwest of Wainwright which reduces the potential impact to subsistence hunting activities occurring along the Chukchi Sea coast. The communication center in Wainwright will be jointly funded by Statoil and other operators, and Statoil will routinely call the communication center according to the established protocol while in the Chukchi Sea. Statoil plans to have one major crew change which will take place in Nome, AK, and will not involve the use of helicopters. Statoil does have a contingency plan for a potential transfer of a small number of crew via ship-to-shore vessel at Wainwright. If this should become necessary, the Wainwright communications center will be contacted to determine the appropriate vessel route and timing to avoid potential conflict with subsistence users.

Following completion of the 2010 Chukchi Sea open water marine seismic surveys, Statoil will conduct a co-management meeting with the commissioners and committee heads to discuss results of mitigation measures and outcomes of the preceding season. The goal of the post-season meeting is to build upon the knowledge base, discuss successful or unsuccessful outcomes of mitigation measures, and possibly refine plans or mitigation measures if necessary.

Mitigation Conclusions

NMFS has carefully evaluated the applicant's proposed mitigation measures and considered a range of other measures in the context of ensuring that NMFS prescribes the means of effecting the least practicable impact on the affected marine mammal species and stocks and their habitat. Our evaluation of potential measures included consideration of the following factors in relation to one another:

- The manner in which, and the degree to which, the successful implementation of the measure is expected to minimize adverse impacts to marine mammals;
- The proven or likely efficacy of the specific measure to minimize adverse impacts as planned; and
- The practicability of the measure for applicant implementation.

Based on our evaluation of the applicant's proposed measures, as well as other measures considered by NMFS, NMFS has determined that the proposed mitigation measures provide the means of effecting the least practicable impact on marine mammal species or stocks and their habitat, paying particular attention to rookeries, mating grounds, and areas of similar significance.

Monitoring and Reporting Measures

In order to issue an ITA for an activity, Section 101(a)(5)(D) of the MMPA states that NMFS must set forth "requirements pertaining to the monitoring and reporting of such taking". The MMPA implementing regulations at 50 CFR 216.104 (a)(13) indicate that requests for ITAs must include the suggested means of accomplishing the necessary monitoring and reporting that will result in increased knowledge of the species and of the level of taking or impacts on populations of marine mammals that are expected to be present in the proposed action area.

Monitoring Measures

The following monitoring measures are required for Statoil's 2010 open water marine seismic surveys in the Chukchi Sea.

(1) Vessel-Based MMOs

Vessel-based monitoring for marine mammals will be done by trained MMOs throughout the period of marine survey activities. MMOs will monitor the occurrence and behavior of marine mammals near the survey vessel during all daylight periods during operation and during most daylight periods when airgun operations are not occurring. MMO duties will include watching for and identifying marine mammals, recording their numbers, distances, and reactions to the survey operations, and documenting "take by harassment" as defined by NMFS.

A sufficient number of MMOs will be required onboard the survey vessel to meet the following criteria: (1) 100% monitoring coverage during all periods of survey operations in daylight; (2) maximum of 4 consecutive hours on watch per MMO; and (3) maximum of 12 hours of watch time per day per MMO.

During seismic operations when there is 24 hrs of daylight, five MMOs will be based aboard the seismic source vessel and at least three MMOs on the chase/monitoring vessels.

MMO teams will consist of Inupiat observers and experienced field biologists. An experienced field crew leader will supervise the MMO team onboard the survey vessel. New observers shall be paired with experienced observers to avoid situations where lack of experience impairs the quality of observations. The total number of MMOs may decrease later in the season as the duration of daylight decreases.

Statoil anticipates one crew change to occur approximately half-way through the season. During crew rotations detailed hand-over notes will be provided to the incoming crew leader by the outgoing leader. Other communications such as email, fax, and/or phone communication between the current and oncoming crew leaders during each rotation will also occur when possible. In the event of an unexpected crew change Statoil will facilitate such communications to insure monitoring consistency among shifts.

Crew leaders and most other biologists serving as observers in 2010 will be individuals with experience as observers during one or more of the 1996–2009 seismic or shallow hazards monitoring projects in Alaska, the Canadian Beaufort, or other offshore areas in recent years.

Biologist-observers will have previous marine mammal observation experience, and field crew leaders will be highly experienced with previous vessel-based marine mammal monitoring and mitigation projects. Resumes for those individuals will be provided to NMFS for review and acceptance of their qualifications. Inupiat observers will be experienced in the region, familiar with the marine mammals of the area, and complete a NMFS-approved observer training course designed to familiarize individuals with monitoring and data collection procedures. A marine mammal observers' handbook, adapted for the specifics of the planned survey program, will be prepared and distributed beforehand to all MMOs.

Most observers, including Inupiat observers, will also complete a two-day training and refresher session on marine mammal monitoring, to be conducted shortly before the anticipated start of the 2010 open-water season. Any exceptions will have or receive equivalent experience or training. The training session(s) will be conducted by qualified marine mammalogists with extensive crew-leader experience during previous vessel-based seismic monitoring programs. Observers should be trained using visual aids (*e.g.,* videos, photos), to help them identify the species that they are likely to encounter in the conditions under which the animals will likely be seen.

If there are Alaska Native MMOs, the MMO training that is conducted prior to the start of the survey activities should be conducted with both Alaska Native MMOs and biologist MMOs being trained at the same time in the same room. There should not be separate training courses for the different MMOs.

Primary objectives of the training include:

- Review of the marine mammal monitoring plan for this project, including any amendments specified by NMFS in the IHA, by USFWS and by MMS, or by other agreements in which Statoil may elect to participate;
- Review of marine mammal sighting, identification, and distance estimation methods;
- Review of operation of specialized equipment (reticle binoculars, night vision devices, and GPS system);
- Review of, and classroom practice with, data recording and data entry systems, including procedures for recording data on marine mammal sightings, monitoring operations, environmental conditions, and entry error control. These procedures will be implemented through use of a customized computer database and laptop computers; and
- Review of the specific tasks of the Inupiat Communicator.

Observers should understand the importance of classifying marine mammals as "unknown" or "unidentified" if they cannot identify the animals to species with confidence. In those cases, they should note any information that might aid in the identification of the marine mammal sighted. For example, for an unidentified mysticete whale, the observers should record whether the animal had a dorsal fin.

MMOs will watch for marine mammals from the best available vantage point on the survey vessel, typically the bridge. MMOs will scan systematically with the unaided eye and 7 x 50 reticle binoculars, supplemented with 20 x 60 image-stabilized Zeiss Binoculars or Fujinon 25 x 150 "Big-eye" binoculars and night-vision equipment when needed. With two or three observers on watch, the use of big eyes should be paired with searching by naked eye, the latter allowing visual coverage of nearby areas to detect marine mammals. Personnel on the bridge will assist the MMOs in watching for marine mammals.

Observers should attempt to maximize the time spent looking at the water and guarding the safety radii. They should avoid the tendency to spend too much time evaluating animal behavior or entering data on forms, both of which detract from their primary purpose of monitoring the safety zone.

Observers should use the best possible positions for observing (*e.g.,* outside and as high on the vessel as possible), taking into account weather and other working conditions. MMOs shall carefully document visibility during observation periods so that total estimates of take can be corrected accordingly.

Information to be recorded by marine mammal observers will include the same types of information that were recorded during recent monitoring programs associated with Industry activity in the Arctic (*e.g.,* Ireland *et al.,* 2009). When a mammal sighting is made, the following information about the sighting will be recorded:

(A) Species, group size, age/size/sex categories (if determinable), behavior when first sighted and after initial sighting, heading (if consistent), bearing and distance from the MMO, apparent reaction to activities (*e.g.,* none, avoidance, approach, paralleling, etc.), closest point of approach, and behavioral pace;

(B) Time, location, speed, activity of the vessel, sea state, ice cover, visibility, and sun glare;

(C) The positions of other vessel(s) in the vicinity of the MMO location; and

(D) Whether adjustments were made to Statoil's activity status.

The ship's position, speed of support vessels, and water temperature, water depth, sea state, ice cover, visibility, and sun glare will also be recorded at the start and end of each observation watch, every 30 minutes during a watch, and whenever there is a change in any of those variables.

Distances to nearby marine mammals will be estimated with binoculars (Fujinon 7 x 50 binoculars) containing a reticle to measure the vertical angle of the line of sight to the animal relative to the horizon. MMOs may use a laser rangefinder to test and improve their

abilities for visually estimating distances to objects in the water. However, previous experience showed that a Class 1 eye-safe device was not able to measure distances to seals more than about 230 ft (70 m) away. The device was very useful in improving the distance estimation abilities of the observers at distances up to about 1,968 ft (600 m)—the maximum range at which the device could measure distances to highly reflective objects such as other vessels. Humans observing objects of more-or-less known size via a standard observation protocol, in this case from a standard height above water, quickly become able to estimate distances within about ± 20% when given immediate feedback about actual distances during training.

Statoil plans to conduct the marine seismic survey 24 hr/day. Regarding nighttime operations, note that there will be no periods of total darkness until mid-August. When operating under conditions of reduced visibility attributable to darkness or to adverse weather conditions, night-vision equipment ("Generation 3" binocular image intensifiers, or equivalent units) will be available for use.

(2) Acoustic Monitoring

Sound Source Measurements

As described above, previous measurements of airguns in the Chukchi Sea were used to estimate the distances at which received levels are likely to fall below 120, 160, 180, and 190 dB re 1 μPa (rms) from the planned airgun sources. These modeled distances will be used as temporary safety radii until measurements of the airgun sound source are conducted. The measurements will be made at the beginning of the field season and the measured radii used for the remainder of the survey period. An acoustics contractor with experience in the Arctic conducting similar measurements in recent years will use their equipment to record and analyze the underwater sounds and write the summary reports as described below.

The objectives of the sound source verification measurements planned for 2010 in the Chukchi Sea will be (1) to measure the distances in the broadside and endfire directions at which broadband received levels reach 190, 180, 170, 160, and 120 dB re 1 μPa (rms) for the energy source array combinations that may be used during the survey activities. The configurations will include at least the full array and the operation of a single mitigation source that will be used during power downs. The measurements of energy source array sounds will be made by an acoustics contractor at the beginning of the survey and the distances to the various radii will be reported as soon as possible after recovery of the equipment. The primary radii of concern will be the 190 and 180 dB safety radii for pinnipeds and cetaceans, respectively, and the 160 dB disturbance radii. In addition to reporting the radii of specific regulatory concern, nominal distances to other sound isopleths down to 120 dB re 1 μPa (rms) will be reported in increments of 10 dB.

Data will be previewed in the field immediately after download from the hydrophone instruments. An initial sound source analysis will be supplied to NMFS and the airgun operators within 120 hours of completion of the measurements, if possible. The report will indicate the distances to sound levels based on fits of empirical transmission loss formulae to data in the endfire and broadside directions. A more detailed report will be issued to NMFS as part of the 90-day report following completion of the acoustic program.

2010 Shared Science Program

Statoil, Shell, and ConocoPhillips (CPAI) are jointly funding an extensive science program in the Chukchi Sea. This program will be carried out by Olgoonik-Fairweather LLC (OFJV) with the vessels Norseman II and Westward Wind during the 2010 open water season. The science program is not part of the Statoil seismic program, but worth mentioning in this context due to the acoustic monitoring array deployed within the seismic survey area as shown in Figures 1 and 2 of Statoil's IHA application. The science program components include:

- Acoustics Monitoring
- Fisheries Ecology
- Benthic Ecology
- Plankton Ecology
- Mammals
- Seabirds
- Physical Oceanography

The 2010 program continues the acoustic monitoring programs of 2006–2009 with a total of 44 acoustic recorders distributed both broadly across the Chukchi lease area and nearshore environment and intensively on the Statoil, Burger (Shell), and Klondike (CPAI) lease holdings. The recorders will be deployed in late July or early August and will be retrieved in early to mid-October, depending on ice conditions. The recorders will be the Advanced Multi-Channel Acoustic Recorder (AMAR) and the Autonomous Underwater Recorder for Acoustic Listening (AURAL) model acoustic buoys set to record at 16 kHz sample rate. These are the same recorder models and same sample rates that have been used for this program from 2006–2009. The broad area arrays are designed to capture both general background soundscape data, seismic survey sounds and marine mammal call data across the lease area. From these recordings we have been able to gain insight into large-scale distributions of marine mammals, identification of marine mammal species present, movement and migration patterns, and general abundance data. The site specific focused arrays are designed to also support localization of marine mammal calls on and around the leaseholdings. In the case of the Statoil prospect, where Statoil intends to conduct seismic data acquisition in 2010, localized calls will enable investigators to understand responses of marine mammals to survey operations both in terms of distribution around the operation and behavior (*i.e.,* calling behavior). The site specific array will consist of 7 AMAR recorders deployed in a hexagonal configuration as shown in Figure 2 of Statoil's 4MP, with inter-recorder spacing of 8 km (12.9 mi). These recorders are the same types that were used successfully in the 2009 site-specific acoustic monitoring program on Shell and CPAI prospects. The recorded sample resolution is 24-bits and sample frequency is 16 kHz, which is sufficient to capture part or all of the sounds produced by the marine mammal species known to be present, with the exception of harbor porpoise. The recorders will be synchronized to support localization of calling bowhead whales. Other species' calls are typically detected from distances less than the 8 km recorder separation. Consequently the multi-sensor triangulation method, that is used for bowheads calls, will not be used to determine calling locations of other species; however, detection of other species' calls indicates the animal's position within a circular region of radius equal to the maximum detection distances of a few kilometers.

Reporting Measures

(1) SSV Report

A report on the preliminary results of the acoustic verification measurements, including as a minimum the measured 190-, 180-, 160-, and 120-dB re 1 μPa (rms) radii of the source vessel(s) and the support vessels, will be submitted within 120 hr after collection and analysis of those measurements at the start of the field season. This report will specify the distances of the safety zones

that were adopted for the marine survey activities.

(2) Technical Reports

The results of Statoil's 2010 open water marine seismic survey monitoring program (*i.e.,* vessel-based and acoustic), including estimates of "take" by harassment, will be presented in the "90-day" and Final Technical reports. The Technical Reports will include: (a) Summaries of monitoring effort (*e.g.,* total hours, total distances, and marine mammal distribution through the study period, accounting for sea state and other factors affecting visibility and detectability of marine mammals); (b) analyses of the effects of various factors influencing detectability of marine mammals (*e.g.,* sea state, number of observers, and fog/glare); (c) species composition, occurrence, and distribution of marine mammal sightings, including date, water depth, numbers, age/size/gender categories (if determinable), group sizes, and ice cover; (d) analyses of the effects of survey operations; (e) sighting rates of marine mammals during periods with and without airgun activities (and other variables that could affect detectability); (f) initial sighting distances versus airgun activity state; (g) closest point of approach versus airgun activity state; (h) observed behaviors and types of movements versus airgun activity state; (i) numbers of sightings/individuals seen versus airgun activity state; (j) distribution around the survey vessel versus airgun activity state; and (k) estimates of take by harassment. In addition, Statoil shall provide all spatial data on charts (always including vessel location) and make all data available in the report, preferably electronically, for integration with data from other companies. Statoil shall also accommodate specific requests for raw data, including tracks of all vessels and aircraft (if available) associated with the operation and activity logs documenting when and what types of sounds are introduced into the environment by the operation.

The initial technical report is due to NMFS within 90 days of the completion of Statoil's Chukchi Sea open water marine seismic surveys. The "90-day" report will be subject to review and comment by NMFS. Any recommendations made by NMFS must be addressed in the final report prior to acceptance by NMFS.

(3) Comprehensive Report

Following the 2010 open-water season a comprehensive report describing the vessel-based monitoring and acoustic monitoring programs will be prepared. The comprehensive report will describe the methods, results, conclusions and limitations of each of the individual data sets in detail. The report will also integrate (to the extent possible) the studies into a broad-based assessment of industry activities, and other activities that occur in the Chukchi Sea, and their impacts on marine mammals during 2010. The report will help to establish long-term data sets that can assist with the evaluation of changes in the Chukchi Sea ecosystem. The report will attempt to provide a regional synthesis of available data on industry activity in offshore areas of northern Alaska that may influence marine mammal density, distribution and behavior.

(4) Notification of Injured or Dead Marine Mammals

Statoil will notify NMFS' Office of Protected Resources and NMFS' Stranding Network within 48 hours of sighting an injured or dead marine mammal in the vicinity of marine survey operations. Statoil will provide NMFS with the species or description of the animal(s), the condition of the animal(s) (including carcass condition if the animal is dead), location, time of first discovery, observed behaviors (if alive), and photo or video (if available).

In the event that an injured or dead marine mammal is found by Statoil that is not in the vicinity of the proposed open water marine survey program, Statoil will report the same information as listed above as soon as operationally feasible to NMFS.

Negligible Impact and Small Numbers Analysis and Determination

NMFS has defined "negligible impact" in 50 CFR 216.103 as "* * * an impact resulting from the specified activity that cannot be reasonably expected to, and is not reasonably likely to, adversely affect the species or stock through effects on annual rates of recruitment or survival." In making a negligible impact determination, NMFS considers a variety of factors, including but not limited to: (1) The number of anticipated mortalities; (2) the number and nature of anticipated injuries; (3) the number, nature, intensity, and duration of Level B harassment; and (4) the context in which the takes occur.

No injuries or mortalities are anticipated to occur as a result of Statoil's proposed 2010 open water marine seismic surveys in the Chukchi Seas, and none are proposed to be authorized. Additionally, animals in the area are not expected to incur hearing impairment (*i.e.,* TTS or PTS) or non-auditory physiological effects. Takes will be limited to Level B behavioral harassment. Although it is possible that some individuals of marine mammals may be exposed to sounds from marine survey activities more than once, the expanse of these multi-exposures are expected to be less extensive since both the animals and the survey vessels will be moving constantly in and out of the survey areas.

Most of the bowhead whales encountered during the summer will likely show overt disturbance (avoidance) only if they receive airgun sounds with levels ≥160 dB re 1 μPa (rms). Odontocete reactions to seismic energy pulses are usually assumed to be limited to shorter distances from the airgun(s) than are those of mysticetes, probably in part because odontocete low-frequency hearing is assumed to be less sensitive than that of mysticetes. However, at least when in the Canadian Beaufort Sea in summer, belugas appear to be fairly responsive to seismic energy, with few being sighted within 6–12 mi (10–20 km) of seismic vessels during aerial surveys (Miller *et al.,* 2005). Belugas will likely occur in small numbers in the Chukchi Sea during the survey period and few will likely be affected by the survey activity. In addition, due to the constant moving of the seismic survey vessel, the duration of the noise exposure by cetaceans to seismic impulse would be brief. For the same reason, it is unlikely that any individual animal would be exposed to high received levels multiple times.

Taking into account the mitigation measures that are planned, effects on cetaceans are generally expected to be restricted to avoidance of a limited area around the survey operation and short-term changes in behavior, falling within the MMPA definition of "Level B harassment". Furthermore, the estimated numbers of animals potentially exposed to sound levels sufficient to cause appreciable disturbance are very low percentages of the population sizes in the Bering-Chukchi-Beaufort seas, as described above.

The many reported cases of apparent tolerance by cetaceans of seismic exploration, vessel traffic, and some other human activities show that co-existence is possible. Mitigation measures such as controlled vessel speed, dedicated marine mammal observers, non-pursuit, and shut downs or power downs when marine mammals are seen within defined ranges will further reduce short-term reactions and minimize any effects on hearing sensitivity. In all cases, the effects are expected to be short-term, with no lasting biological consequence.

Some individual pinnipeds may be exposed to sound from the proposed

marine surveys more than once during the time frame of the project. However, as discussed previously, due to the constant moving of the survey vessel, the probability of an individual pinniped being exposed multiple times is much lower than if the source is stationary. Therefore, NMFS has preliminarily determined that the exposure of pinnipeds to sounds produced by the proposed marine seismic survey in the Chukchi Sea is not expected to result in more than Level B harassment and is anticipated to have no more than a negligible impact on the animals.

Of the twelve marine mammal species likely to occur in the proposed marine survey area, only the bowhead, fin, and humpback whales are listed as endangered under the ESA. These species are also designated as "depleted" under the MMPA. Despite these designations, the Bering-Chukchi-Beaufort stock of bowheads has been increasing at a rate of 3.4 percent annually for nearly a decade (Allen and Angliss, 2010). Additionally, during the 2001 census, 121 calves were counted, which was the highest yet recorded. The calf count provides corroborating evidence for a healthy and increasing population (Allen and Angliss, 2010). The occurrence of fin and humpback whales in the proposed marine survey areas is considered very rare. There is no critical habitat designated in the U.S. Arctic for the bowhead, fin, and humpback whale. The bearded and ringed seals are "candidate species" under the ESA, meaning they are currently being considered for listing but are not designated as depleted under the MMPA. None of the other three species that may occur in the project area are listed as threatened or endangered under the ESA or designated as depleted under the MMPA.

Potential impacts to marine mammal habitat were discussed previously in this document (see the "Anticipated Effects on Habitat" section). Although some disturbance is possible to food sources of marine mammals, the impacts are anticipated to be minor enough as to not affect rates of recruitment or survival of marine mammals in the area. Based on the vast size of the Arctic Ocean where feeding by marine mammals occurs versus the localized area of the marine survey activities, any missed feeding opportunities in the direct project area would be minor based on the fact that other feeding areas exist elsewhere.

The estimated takes proposed to be authorized represent 4.95% of the Eastern Chukchi Sea population of approximately 3,700 beluga whales (Angliss and Allen, 2009), 0.62% of Aleutian Island and Bering Sea stock of approximately 340 killer whales, 0.04% of Bering Sea stock of approximately 48,215 harbor porpoises, 0.81% of the Eastern North Pacific stock of approximately 17,752 gray whales, 1.11% of the Bering-Chukchi-Beaufort population of 14,247 individuals assuming 3.4 percent annual population growth from the 2001 estimate of 10,545 animals (Zeh and Punt, 2005), 0.21% of the Western North Pacific stock of approximately 938 humpback whales, 0.03% of the North Pacific stock of approximately 5,700 fin whales, and 0.19% of the Alaska stock of approximately 1,003 minke whales. The take estimates presented for bearded, ringed, spotted, and ribbon seals represent 0.09, 2.81, 0.22, and 0.01 percent of U.S. Arctic stocks of each species, respectively. These estimates represent the percentage of each species or stock that could be taken by Level B behavioral harassment if each animal is taken only once. In addition, the mitigation and monitoring measures (described previously in this document) proposed for inclusion in the IHA (if issued) are expected to reduce even further any potential disturbance to marine mammals.

Based on the analysis contained herein of the likely effects of the specified activity on marine mammals and their habitat, and taking into consideration the implementation of the mitigation and monitoring measures, NMFS finds that Statoil's proposed 2010 open water marine seismic survey in the Chukchi Sea may result in the incidental take of small numbers of marine mammals, by Level B harassment only, and that the total taking from the marine surveys will have a negligible impact on the affected species or stocks.

Unmitigable Adverse Impact Analysis and Determination

NMFS has determined that Statoil's proposed 2010 open water marine seismic survey in the Chukchi Sea will not have an unmitigable adverse impact on the availability of species or stocks for taking for subsistence uses. This determination is supported by information contained in this document and Statoil's POC. Statoil has adopted a spatial and temporal strategy for its Chukchi Sea operations that should minimize impacts to subsistence hunters. Statoil will enter the Chukchi Sea far offshore, so as to not interfere with July hunts in the Chukchi Sea villages. After the close of the July beluga whale hunts in the Chukchi Sea villages, very little whaling occurs in Wainwright, Point Hope, and Point Lay. Although the fall bowhead whale hunt in Barrow will occur while Statoil is still operating (mid- to late-September to October), Barrow is approximately 150 mi (241 km) east of the eastern boundary of the proposed marine seismic survey site. Based on these factors, Statoil's Chukchi Sea seismic survey is not expected to interfere with the fall bowhead harvest in Barrow. In recent years, bowhead whales have occasionally been taken in the fall by coastal villages along the Chukchi coast, but the total number of these animals has been small.

Adverse impacts are not anticipated on sealing activities since the majority of hunts for seals occur in the winter and spring, when Statoil will not be operating. Additionally, most sealing activities occur much closer to shore than Statoil's proposed marine seismic survey area.

Based on the measures described in Statoil's POC, the required mitigation and monitoring measures (described earlier in this document), and the project design itself, NMFS has determined that there will not be an unmitigable adverse impact on subsistence uses from Statoil's open water marine seismic survey in the Chukchi Sea.

Endangered Species Act (ESA)

There are three marine mammal species listed as endangered under the ESA with confirmed or possible occurrence in the proposed project area: Bowhead whale, fin whale, and humpback whale. NMFS' Permits, Conservation and Education Division consulted with NMFS' Alaska Regional Office Division of Protected Resources under section 7 of the ESA on the issuance of an IHA to Statoil under section 101(a)(5)(D) of the MMPA for this activity. A Biological Opinion was issued on July 13, 2010, which concludes that issuance of an IHA is not likely to jeopardize the continued existence of the fin, humpback, or bowhead whale. NMFS has issued an Incidental Take Statement under this Biological Opinion which contains reasonable and prudent measures with implementing terms and conditions to minimize the effects of take of listed species.

National Environmental Policy Act (NEPA)

NMFS prepared an EA that includes an analysis of potential environmental effects associated with NMFS' issuance of an IHA to Statoil to take marine mammals incidental to conducting its

marine survey program in the Beaufort and Chukchi Seas during the 2010 open water season. NMFS has finalized the EA and prepared a FONSI for this action. Therefore, preparation of an EIS is not necessary.

Authorization

As a result of these determinations, NMFS has issued an IHA to Statoil to take marine mammals incidental to its 2010 open water marine seismic surveys in the Chukchi Sea, Alaska, provided the previously mentioned mitigation, monitoring, and reporting requirements are incorporated.

Dated: August 6, 2010.

James H. Lecky,

Director, Office of Protected Resources, National Marine Fisheries Service.

[FR Doc. 2010–19962 Filed 8–12–10; 8:45 am]

BILLING CODE 3510–22–P